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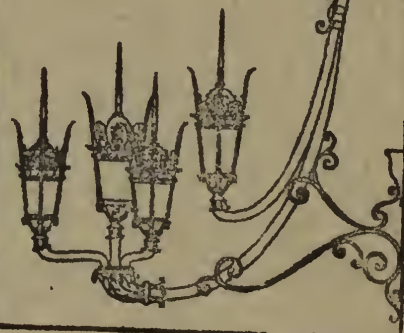
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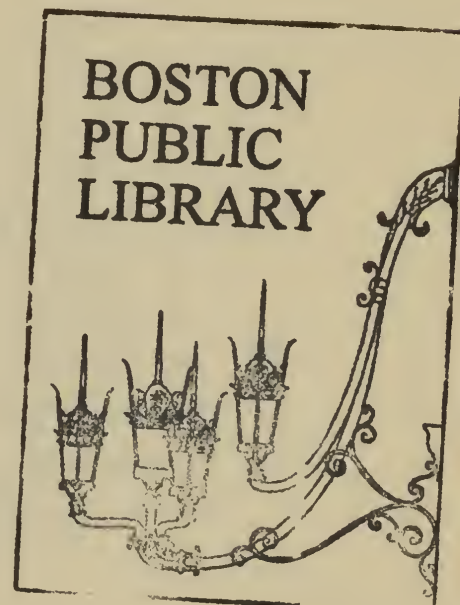


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PART I

CONTRACT FORM

CITY OF BOSTON

PUBLIC WORKS DEPARTMENT

NOTICE TO BIDDERS

The Commissioner of Public Works of the City of Boston, hereinafter designated as Commissioner, Room 506, City Hall Annex, invites proposals from citizens of the United States and corporations or other legal associations wherein the controlling interest to the extent of at least over one half thereof is owned by a citizen or citizens of the United States, for:

Each proposal must be submitted on the prescribed proposal form only, endorsed with the name of the bidder in a sealed envelope, marked:

"Proposal for

".

and left at Room 506, fifth floor, City Hall Annex, before 2 P.M.

on.....

accompanied by a properly certified check for.....

..... dollars (\$.....)
payable to, and to become the property of the City, if the proposal after acceptance is not carried out. The proposals will then be publicly opened and read. Proposals must be made in duplicate, the sealed duplicate, without check, to be deposited by the bidder with the City Auditor previous to the time named for opening the proposals.

Before any contract is awarded, the Bidder may be required to furnish, without expense to the Department, a complete statement of the origin, composition and manufacture of any or all materials proposed to be used in the construction of the work, together with all samples, which samples may be subjected to the tests required by the Department to determine their quality and fitness for the work. In order to insure a proper time sequence for required inspection and approval, this information shall be furnished at least two (2) weeks (or as otherwise directed by the Commissioner) in advance of the incorporation of any such materials into the work.

All questions as to the interpretation of the plans and specifications shall be submitted in writing to the Commissioner, and written answers to such questions will be sent by the Commissioner to every individual or firm on record as having taken a set of plans and specifications. No questions will be answered unless received at least forty-eight hours prior to the expiration of the time set for filing bids.

ROBERT P. SHEA,
Commissioner of Public Works.

PROPOSAL

FOR

To the City of Boston, Mass.:

The undersigned, a citizen of the United States, or a corporation wherein the controlling interest to the extent of at least one half thereof is owned by citizens of the United States, declares that the only persons interested in this proposal as principals are named herein as such; that no official of the City, and no person acting for or employed by the City is directly or indirectly interested in this proposal, or in any contract which may be made under it, or in any expected profits to arise therefrom; that this proposal is made in good faith without fraud, collusion, or connection of any kind with any other bidder for the same work, that he is competing in his own interest and in his own behalf without connection or obligation to any undisclosed person and that no other person has any interest in the profits of the contract; that he has carefully examined the annexed contract and specifications and informed himself fully in regard to all conditions pertaining to the work and the place where it is to be done; and that he has made his own examinations and estimates and from them makes this proposal.

The undersigned proposes and agrees that if, within twenty days after the day named for leaving the proposal, notice that this proposal will be accepted for the City shall be mailed to him at the business address given below, or shall be delivered to him, he will, at 11 o'clock a. m. of some day of the six weekdays next after such mailing or delivery, excluding Saturdays, Sundays, and legal holidays, appear at the office of the Commissioner of Public Works, hereinafter designated as Commissioner, and deliver to him, for the City, a contract, and performance and payment bonds (each in the full amount of the contract), all properly executed in the forms annexed, with such changes therein as prior to the day named for the opening of the proposal shall have been made in the copies of the forms kept in said office, the bonds to be satisfactory to the Commissioner, and the contract to be in quadruplicate, and to provide that the City as full payment for doing and completing the work, including everything furnished or done, and every injury or loss sustained by the Contractor in carrying on the contract, shall pay the contract sum specified below, increased, decreased and paid as provided in the contract.

And also agrees that the certified check for
dollars

(\$.....), payable to the City, and deposited herewith, is the property of the City, and the amount thereof is the amount of the damages which the City will sustain by failure to carry out the proposal, but if this proposal is not accepted, or if notice is mailed or delivered and the undersigned executes and delivers said contract and bonds as aforesaid, the check, or its amount, is to be paid to him on receipt therefor.

And further agrees to be bound by both the specifications in detail and the plans which accompany the same, each of which shall be deemed supplementary to the other and in case of any item not being specifically mentioned in detail and yet shown on plan or conversely, the necessary work or materials shall be supplied and installed to the satisfaction of the Commissioner.

The contract sum above referred to is made up of the Items hereinafter specified.

SAMPLE TABULATION SHEET FOR LISTING PROPOSAL ITEMS

TIME IS THE ESSENCE OF THIS CONTRACT

The Contractor hereby offers to provide all necessary machinery, tools, apparatus and other means for construction, and do all the work, and furnish all the material called for by said specifications in the manner and time herein prescribed and according to the requirements of the Commissioner, including all the incidental work, and complete the work on or before.....

for the following sums, to wit:

ITEM No.	Quantity.	Item with Unit Bid Price Written in Words.	UNIT PRICE.		AMOUNT.	
			Dollars.	Cents.	Dollars.	Cents.
		Trees removed, diameter 4 inches to 12 inches, inclusive, in- cluding stumps, roots, surround- ing bushes, etc., at				
		Each				
		Trees removed, diameter over 12 inches to 24 inches, inclusive, including stumps, roots, sur- rounding bushes, etc., at				
		Each				
		<i>Carried forward</i>				

ITEM No.	Quantity.	Item with Unit Bid Price Written in Words.	UNIT PRICE.		AMOUNT.	
			Dollars.	Cents.	Dollars.	Cents.
		<i>Brought forward</i>	.....	.....	.....	.....
		Trees removed, diameter over 24 inches, including stumps, roots, surrounding bushes, etc., at				
		..... Each	.....	.....	.....	.....
		Stumps removed, diameter inches to inches, inclusive, including roots, surrounding bushes, etc., at				
		..... Each	.....	.....	.....	.....
		Cubic yards, in place, of exca- vation for sub-grading, made and removed, at				
		..... Per cubic yard	.....	.....	.....	.....
		Cubic yards, in place, of exca- vation for adjustment of water and sewer services, made and re- moved, at				
		..... Per cubic yard	.....	.....	.....	.....
		Grand Total	.....	.....	.....	.....

Bidder.....

By.....

Business Address.....

Tel. No.....

The bidder is a (an).....
 (Individual) (Partnership) (Corporation)

The full names and addresses of all persons interested in this proposal, as principals, are as follows:

.....

Individual Owner:

State full name and address of owner. If business is carried on in any name other than that of the owner, state such name and address.

.....

Partnership:

State full name and address of all partners.

.....

Corporation:

Corporation is incorporated in the State of

President is

Treasurer is

Place of business in Boston is

NOTE.—This proposal must bear the written signature of the bidder.

If the bidder is an individual doing business under a name other than his own name, the proposal must so state, giving the address of the individual.

If the bidder is a partnership, the proposal must so state, setting forth the names and addresses of all partners and must be signed by a partner designated as such.

If the bidder is a corporation, the proposal must bear the seal of the corporation and must be signed by a duly authorized officer or agent of such corporation.

If the price of any item appears to the Commissioner to be abnormally high or low, or the bidder neglects to bid on each and every item, it may lead to the rejection of the proposal.

It is the purpose of the Commissioner not to award the contract to any bidder who does not furnish evidence satisfactory to the Commissioner that he has ability and experience in this class of work, and that he has sufficient capital and plant to enable him to prosecute the same successfully, and to complete it within the time named in the contract.

The bidder shall submit his proposal upon the blank forms furnished by the Department. The bidder shall specify a unit price, in both words and figures, for each item for which a quantity is given, and shall also show the products of the respective unit prices and quantities written in figures in the column provided for that purpose, and the total amount of the proposal obtained by adding the amounts of the several items. All words and figures shall be in ink. In case of a discrepancy between the prices written in words and those written in figures, the written words shall govern. In the event there is a discrepancy between the unit prices and the total sum of all items, the unit prices shall govern.

In the event there is a discrepancy between the proposal submitted to the Department and the proposal submitted to the City Auditor, the proposal submitted to the City Auditor shall be treated as the official bid in accordance with the City Charter.

The Commissioner reserves the right to reject any or all proposals, or to accept any proposal should he deem it to be for the best interest of the City so to do.

The proposal must be made in duplicate, the sealed duplicate, without check, to be deposited by the bidder with the City Auditor previous to the time named for opening the bids.

END OF PROPOSAL.

CONTRACT

Meaning of terms.

The CITY OF BOSTON, a municipal corporation in the State of Massachusetts, and the other party to this contract agree as hereinafter set forth, said other party being intended wherever the word Contractor is used, and the Commissioner of Public Works of said City, or such other person as shall at any time be designated by the Mayor to have charge of the work in the place of the Commissioner, being intended wherever the word Commissioner is used.

ARTICLE 1

City not to be responsible for certain things.

The Contractor has made his proposal from his own examinations and estimates, and shall not hold the City, its agents or employees, responsible for, or bound by, any schedule, estimate, sounding, boring or any plan of any thereof; shall, if any error in any plan, drawing, specification or direction relating to anything to be done under the contract comes to his knowledge, report it at once to the Commissioner; shall not, except as the Commissioner shall authorize in writing, assign or let any part of the contract or of anything to be done thereunder; shall, subject to the provisions of the contract, take all responsibility of and bear all losses resulting to him in carrying it on; and shall assume the defence of, and hold the City, its agents and employees harmless from, all suits and claims against them, or any of them, arising from the use of any invention, patent or patent right, material, labor or implement by, or from any act, omission, or neglect of, the Contractor, his agents or employees in carrying on the contract.

Contractor not to assign anything but to bear all responsibility and defend the City.

ARTICLE 2

The work and manner of doing it.

The Contractor shall do the work as set forth in the proposal annexed hereto, which proposal, as well as the definitions, are incorporated herein by reference and made a part hereof, and do it in the manner set forth in the specifications of the contract, except that the City, by order in writing of the Commissioner, from time to time given to the Contractor or his foreman, may change, increase or take away any part of the work, or change the specifications, plans, drawings, form or materials thereof, or require the Contractor to hasten the work.

Changes may be made.

The Contractor shall do any work not herein otherwise provided for when and as ordered in writing by the Commissioner, such written order to contain particular reference to this Article and to the method of payment.

Extra work.

Extra work will be paid for on a lump sum or unit price basis, if agreeable to the Contractor and the Commissioner, or on a force account basis if the Commissioner so directs.

When directed by the Commissioner to do so, the Contractor shall submit promptly in writing an offer to do the required extra work as specified by the Commissioner, and he may also require that the stated price be itemized as set forth under Article 3.

If the Contractor performs any work or furnishes any material which is not provided for in this contract, or which was not authorized in writing by the Commissioner, said Contractor shall receive no compensation for such work or material so furnished.

Unless specifically noted in the extra work order, extra work will not extend the time of completion of the contract. Payment for authorized extra work will be made in accordance with the provisions of Article 3.

ARTICLE 3

Extra work will be paid for in accordance with the accepted and approved extra work order. Payment for extra work.

Unless an agreed price for the extra work ordered by the Commissioner in accordance with Article 2 is set forth in the extra work order, the Contractor shall accept as full payment therefor an amount equal to the following: (1) the actual cost for direct labor, material and use of equipment, plus 10 per cent of this total for overhead; (2) plus actual cost of Workmen's Compensation and Liability Insurances, health and welfare benefits, Social Security deductions, and Employment Security benefits; (3) plus 6 per cent of the total of (1) and (2).

The immediately foregoing method of payment shall apply to the item of extra work, whether work under said item is performed by the Contractor or by his subcontractor. If this work is done by a subcontractor, no percentage will be added except those specified in the preceding paragraph; it being expressly agreed that the cost to the City will be the same whether the work is done by a subcontractor or the Contractor.

No allowance shall be made for general superintendence and the use of small tools and manual equipment.

The Contractor shall, when requested in writing by the Commissioner, furnish itemized statements of the cost of the work ordered and give the Commissioner access to accounts, bills and vouchers relating thereto, and unless the Contractor shall furnish such itemized statements, access to accounts, bills and vouchers, he shall not be entitled to payment for any items of extra work for which such information is desired and requested by the Commissioner as aforesaid.

The determination of the Commissioner shall be final upon all questions of the amount and value of extra work.

ARTICLE 4

The quantities mentioned in the contract are merely estimates of what will probably be required, and the Department reserves the right to increase or diminish the quantities in any of the items as it may deem necessary, without change of price per unit, provided that the increase of the sum of all said items, as determined by the Engineer's final estimate, does not exceed 25 per cent of the total of the original proposal. Estimated quantity items.

ARTICLE 5

The Contractor shall, within one week after he shall have been caused any loss or injury by the City, deliver to the City Auditor and the Commissioner full statements, in writing, of such loss or injury, and of the items and cause thereof; and no sum shall be allowed on account of any such loss or injury unless a statement as aforesaid is so delivered to the City Auditor and another to the Commissioner, or the Mayor approves the sum. Claims for loss or injury to be made at once.

ARTICLE 6

In addition to doing the work set forth in the proposal annexed hereto at the locations specifically stated in said proposal, the Contractor shall also do said work or such item or items thereof as the Commissioner of Public Works may direct by written order or orders given to the Contractor not later than twenty (20) calendar days prior to the (a) completion date set forth in the Proposal or (b) a completion date, subsequent in time to the date set forth in the Proposal, as may be agreed upon by a written agreement of the Contractor, the surety on his or its bonds, and the said Commissioner, with the approval of the Mayor affixed thereto, in such additional locations, if any, in said Ward(s) . . . as said Commissioner may in said order or orders designate; provided, however, that the total cost of all work under this contract, including the work under this Article, shall in no event exceed the grand Work at additional locations.

total stated in the proposal, plus twenty-five per cent (25%) of said grand total. The work to be performed under this Article shall be subject to all terms and conditions of this contract and the specifications annexed hereto, including, without limiting the generality of the foregoing, the Guaranty For All Pavements provisions on page 82 of said specifications.

ARTICLE 7

Referee's
determinations
and directions
to be followed.

The Contractor in carrying on the contract shall conform to all determinations and directions of the Commissioner relating to — the proper interpretations of the specifications, plans or drawings — the fitness of persons employed on the work or the number thereof — the suitability, amount, quality and value of anything done or used — any injury or loss sustained by the Contractor, and the amount thereto, or any expense, loss or damage incurred by the City, and the amount thereof, or — the date of the completion of the work; the Commissioner shall be the referee of both parties to make such determinations and directions and the Contractor shall permit the Commissioner and persons designated by him to enter upon the work and inspect the same at all times and in all places, and shall provide safe and convenient facilities for making such entry and inspection.

Persons to be
allowed on the
work.

The Commissioner shall decide all questions which may arise as to the quantity, quality, acceptability, fitness and rate of progress of the several kinds of work to be performed and materials to be furnished under the contract, and shall decide all questions which may arise as to the interpretation of any part of the contract, including the plans and specifications which are a part thereof, as to the full performance of this contract on the part of the Contractor, and the determination and decision of the Commissioner shall be final and conclusive; and such determination and decision, in case any question shall arise, shall be a condition precedent to the right of the Contractor to receive any payment under this contract.

ARTICLE 8

Authority and
duties of
Commissioner's
assistants.

The Commissioner may appoint such assistants, generally referred to as Inspectors and Engineers, as he desires and they shall be authorized to inspect work and materials, to furnish lines and grades, to give directions pertaining to the work or to the safety and convenience of the public, to approve or reject materials, to make measurements of quantities, and to perform such other duties as may be designated by the Commissioner.

In case of any dispute arising between the Contractor and the Commissioner's assistants, as to materials furnished or the manner of performing the work, the Commissioner's assistants shall have the authority to reject the materials or to suspend the work until the question at issue can be referred to and decided by the Commissioner.

Commissioner's assistants are not authorized to revoke, alter, enlarge, relax, lessen, waive or release any requirements of, nor to issue instructions contrary to the plans and specifications. They shall in no case act as foremen or perform other duties for the Contractor.

ARTICLE 9

Inspection of
work and
materials.

The Commissioner, his assistants and agents, and employees of the City may for any purpose enter upon the work and premises used by the Contractor. The Contractor shall provide safe and proper facilities therefor.

The Contractor shall furnish the Commissioner or his authorized assistants with every reasonable facility and assistance for ascertaining whether or not the work as performed is in accordance with the requirements and intent of the plans and specifications.

The inspection of the work shall not relieve the Contractor of any of his obligations to fulfill the terms of the contract and/or the plans and specifications.

The Contractor shall furnish written information to the Commissioner, stating the original source of supply and dates of manufacture of all materials manufactured away from the actual site of the work.

The Contractor shall notify the Commissioner as soon as any materials are delivered to the site, allow them to be examined by the Commissioner or an assistant, and furnish men to assist therewith.

Failure to reject any defective work or materials shall not in any way prevent later rejection when such defect is discovered, or obligate the City to make final acceptance.

The Contractor shall take charge of, and be liable for, any loss of, or injury to, the materials for the use of the Contractor, delivered at, or in the vicinity of, the place where the work is being done, whether furnished by the City or otherwise.

ARTICLE 10

The Contractor shall have at all times a competent and reliable superintendent or foreman on the work, authorized to receive orders and to act for him. Whenever the Contractor is not present on any part of the work when it may be desired to give directions, orders will be given by the Commissioner or his assistants, and they shall be received and executed by the foreman or superintendent who is in charge of the particular work in reference to which the orders are given. Co-operation by Contractor.

The Contractor shall provide all reasonable facilities to enable the Commissioner or his assistants to inspect the workmanship and materials entering into the work.

The Contractor shall furnish, free of charge, all stakes and labor for driving stakes, and shall give the Commissioner or his assistants such facilities as they may require for giving lines or grades and these marks or stakes shall be carefully preserved. If any of the construction stakes or marks have been carelessly or wilfully destroyed or disturbed by the Contractor, the cost of replacing them shall be charged against him, and shall be deducted from the payment for the work.

The Contractor shall so carry on his work under the direction of the Commissioner that public service corporations, municipal departments or their contractors, may enter on the work to make changes in their structures or to place new structures and connections therewith without interference, and the Contractor shall have no claim for, or on account of, any delay which may be due to, or result from, said work of public service corporations or municipal departments.

Nothing in this article shall be construed to hold the Contractor responsible for any acts or omissions by public service corporations, municipal departments, or their contractors.

ARTICLE 11

Every employee in the work to be performed under this contract shall be allowed to lodge, board and trade where and with whom he elects and the Contractor shall not directly or indirectly require, as a condition of employment in said work, that an employee shall lodge, board or trade at a particular place or with a particular person. Neither the Contractor nor any subcontractor shall obstruct any person in doing work for the City. The Contractor and any subcontractor shall conform to all the labor laws of the Commonwealth and, without limiting the generality of the foregoing, shall conform to the provisions of sections 25, 26, 27, 27B, and 30 of chapter 149 of the General Laws as amended, which sections are incorporated herein by reference and made a part hereof. Labor provisions.

The Contractor and any subcontractor shall give preference in the employment of mechanics, teamsters, chauffeurs and laborers, first to citizens of the Commonwealth who have served in the army or navy of the United States in time of war and have been honorably discharged therefrom or released from active duty therein and who are qualified to perform the work to which the employment relates; and secondly, to citizens of the Com-

monwealth generally, and if they cannot be obtained in sufficient numbers then to citizens of the United States; and shall give preference to veterans and citizens who are residents of the City of Boston.

No laborer, workman or mechanic working within this Commonwealth in the employ of the Contractor, subcontractor, or other person doing or contracting to do the whole or a part of any work performed under this contract, shall be permitted or required to work more than eight hours in any one calendar day or more than forty-eight hours in any one week or more than six days in any week except in cases of extraordinary emergency.

The rate per hour of the wages to be paid to mechanics, teamsters, chauffeurs and laborers in the work to be performed under this contract shall not be less than the rate of wages in the schedule annexed hereto and made a part hereof as determined by the Commissioner of Labor and Industries of the Commonwealth. This schedule shall continue to be the minimum rate of wages for said employees during the life of this contract.

CHAPTER 606 OF THE ACTS OF 1956.

AN ACT RELATIVE TO THE RATE OF WAGES TO BE PAID TO CERTAIN PERSONS EMPLOYED ON PUBLIC WORKS PROJECTS.

Section 27 of chapter 149 is hereby amended by striking out the last sentence, as amended by chapter 180 of the acts of 1955, and inserting in place thereof the following three sentences:— The aforesaid rates of wages in the schedule of wage rates shall include payments by employers to health and welfare plans as provided in the previous section, and such payments shall be considered as payments to persons under this section performing work as herein provided. Any employer engaged in the construction of such works who does not make payments to a health and welfare plan, where such payments are included in said rates of wages, shall pay the amount of said payments directly to each employee engaged in said construction. Whoever shall pay less than said rate or rates of wages, including payments to health and welfare funds, or the equivalent payment in wages, on said works to any person performing work within classifications as determined by the commissioner, and whoever, for himself, or as representative, agent or officer of another, shall take or receive for his own use or the use of any other person, as a rebate, refund or gratuity, or in any other guise, any part or portion of the wages, including payments to health and welfare funds, or the equivalent payment in wages, paid to any such person for work done or service rendered on said public works, shall be punished by a fine of not less than one hundred nor more than five hundred dollars.

Approved August 6, 1956.

ARTICLE 12

Dump truck
charges.

The Contractor shall pay, or cause to be paid, all rental and transportation charges (whether incurred by the Contractor, subcontractors, or suppliers or transporters of materials to be incorporated in the work) for the hire or use of dump trucks in the carrying out of this contract. The rental rates and transportation charges to be paid for dump trucks hired from any common or contract carrier for use in the prosecution of this contract or for the delivery or transportation of materials to be incorporated in the work shall be the rates and charges specified in the tariff contract filed by such common or contract carrier with the Massachusetts Department of Public Utilities, but shall be not less than the rates and charges set forth in the following order of said Department of Public Utilities:

Ordered, That effective September 1, 1955, the rates and charges, rules and regulations set forth hereinafter shall be the minimum rates and charges for the transportation of road and building materials (except lumber), grading and waste materials, coal and coke in form suitable for dump unloading by both common and contract carriers of property for hire by motor vehicle, the provisions of any tariff or contract to the contrary notwithstanding.

ITEM 1. *Minimum Hourly Rates (for vehicle and driver).**Registered carrying capacity of vehicle.**Rate per hour.**(See Note 1.)*

1,001 lbs.	6,000 lbs.	\$3.50
6,001 lbs.	12,000 lbs.	4.00
12,001 lbs.	16,000 lbs.	4.75
16,001 lbs.	22,000 lbs.	6.00
22,001 lbs.	28,000 lbs.	6.50
28,001 lbs.	and over (2 axles)	7.50
28,001 lbs.	and over (3 axles)	8.50

NOTE 1. The hourly rates set forth above shall apply only when transportation charges are being paid for directly by the Commonwealth or any political subdivision thereof, or when the origin and destination points are both within the same city or town, or within ten (10) air miles of each other.

ITEM 2. *Minimum Tonnage Rate (except Asphalt road-mix).*

<i>Per Mile of Haul</i>	<i>First Mile</i>	<i>Each Succeeding Mile</i>
<i>Rate per ton (2,000 lbs.)</i>	<i>\$0.25</i>	<i>\$0.05</i>
<i>Minimum Yardage Rate</i>		
<i>Per Mile of Haul</i>	<i>First Mile</i>	<i>Each Succeeding Mile</i>
<i>Rate per cubic yard</i>	<i>\$0.35</i>	<i>\$0.08</i>
<i>(Irrespective of commodity density)</i>		

ITEM 3. *Minimum Tonnage Rate (Asphalt road-mix).*

<i>Per Mile of Haul</i>	<i>First Mile</i>	<i>Each Succeeding Mile</i>
<i>Rate per ton (2,000 lbs.)</i>	<i>\$0.30</i>	<i>\$0.05</i>

RULES.

RULE 1. The computation of the mileage charges applicable to the tonnage and yardage rates shall be the accurate mileage from point of loading to point of unloading, said actual mileage to be agreed upon by both the shipper and the carrier. The actual agreed mileage is to be recorded by the carrier on his Freight Bills or Records of Transportation Charges as set forth in Rule 18 (D.P.U. 10405). On fractions of miles, no charges shall be added unless the distance exceeds five-tenths (5/10) of a mile, in which case the charge will be based on the next mile. In the event of disagreement as to the mileage in any particular operation, the mileage shall be that set forth in the "Milo Mileage Guide" adjusted by the actual road mileage from point of loading and point of unloading to the civic centers of the points involved except that in the event of disagreement as to mileage on work being performed under the terms of a contract with the Commonwealth or any agency or political subdivision thereof, the mileage on which transportation charges are based shall be computed and determined by contracting authority or agency as provided by section 39B of chapter 30 of the General Laws, inserted by chapter 694 of the Acts of 1951.

ARTICLE 13

Payment to
subcontractors.

Within ten days after the general Contractor receives payment on account of a periodic estimate of the value of the work done, he shall pay to each subcontractor the sum contained therein for the value of said subcontractor's work, less any amount retained therefrom by the awarding authority under the terms of the general contract or in consequence of any legal proceedings or statutory liens, and less any amount due the general contractor under the subcontract. Not later than the sixty-fifth day after each subcontractor fully completes his portion of the work in accordance with the plans and specifications, the entire balance due under the subcontract shall be due the subcontractor and shall be paid to the general

contractor by the awarding authority for the account of the subcontractor and in partial payment of the amount due under the general contract; provided, however, that the awarding authority may withhold from such partial payment all amounts retained by the awarding authority pending its determination that said portion of the work is satisfactory or in consequence of any legal proceedings or statutory liens. The general contractor shall forthwith pay to the subcontractor the full amount received as aforesaid from the awarding authority for the account of such subcontractor less any amount due the general contractor under the subcontract; and the awarding authority may take such steps as it may deem necessary to arrange that such amounts are paid by the general contractor to the subcontractor forthwith. If, within ten days after the aforementioned sixty-fifth day, the subcontractor has not received from the general contractor the entire balance due on the subcontract less the aforesaid amounts, the subcontractor shall give the awarding authority and the general contractor written notice of such failure to receive payment and of the amount so payable, but not paid, by the general contractor. Thereupon the awarding authority shall make, out of sums payable to the general contractor on the general contract, direct payment to the subcontractor of the entire balance due on the subcontract less the aforesaid amounts. Such direct payment by the awarding authority to any subcontractor and any payment to a general contractor for the account of a subcontractor as hereinbefore provided shall discharge the obligation of the awarding authority to the general contractor to the extent of such payment.

ARTICLE 14

Payment for
labor, materials
and equipment.

The Contractor hereby agrees that he and all subcontractors on the work under this contract shall pay for all labor performed or furnished and materials used or employed in the performance of the work under this contract including lumber so employed which is not incorporated in such work and is not wholly or necessarily consumed or made so worthless as to lose its identity but only to the extent of its purchase price less its fair salvage value, and including also any material specially fabricated at the order of the Contractor or subcontractor for use as a component part of the work under the contract so as to be unsuitable for use elsewhere, even though such material has not been delivered and incorporated into such work, but only to the extent of its purchase price less its fair salvage value and only to the extent that such specially fabricated material is in conformity with the contract, plans and specifications or any changes therein duly made; and shall pay all sums due for the rental or hire of vehicles, steam shovels, rollers propelled by steam or other power, concrete mixers, tools and other appliances and equipment employed in such work, and shall pay all sums due trustees or other persons authorized to collect such payments from the Contractor or subcontractors, based upon the labor performed or furnished as aforesaid for a maximum of one hundred and twenty consecutive calendar days, for health and welfare plans and other fringe benefits which are payable in cash and provided for in collective bargaining agreements between organized labor and the contractor or subcontractors. The contractor hereby further agrees that he shall pay, or cause to be paid, all rental and transportation charges for the hire or use, in the carrying out of the work under this contract, of dump trucks, whether such charges are incurred by the contractor, subcontractors or suppliers or transporters of materials to be incorporated in such work.

ARTICLE 15

Public
Liability
Insurance.

The Contractor shall take out and maintain during the life of this contract such Public Liability and Property Damage Insurance as shall protect him and any subcontractor performing work covered by this contract from claims for damages for personal injury, including wrongful death, as well as from claims for property damage, which may arise from operations

under this contract, whether such operations be by himself or by any subcontractor or by anyone directly or indirectly employed by either of them, and the amounts of such insurance shall be as follows:

(a.) Public Liability Insurance in an amount not less than.....thousand

(.....) dollars for injuries, including wrongful death, to any one person, and,

subject to the same limit for each person, in an amount not less than.....

thousand (.....) dollars on account of one accident; and

(b.) Property Damage Insurance in an amount not less than.....

thousand (.....) dollars for damage on account of any one accident and in an

amount not less than.....thousand (.....) dollars for damages

on account of all accidents, provided, however, that, with the approval of the Commissioner of Public Works, the City may accept insurance covering a subcontractor in character and amounts less than the above requirements where such requirements, in the opinion of the Commissioner of Public Works, are excessive because of the character or extent of the work to be performed by such subcontractor.

No work shall be commenced on the site by the Contractor or any subcontractor until copies of the certificates of the required insurances have been furnished to the Commissioner of Public Works.

ARTICLE 16

Before commencing performance of this contract, the Contractor shall provide by insurance for the payment of compensation and the furnishing of other benefits under chapter 152 of the General Laws (the Workmen's Compensation Law so called) to all persons to be employed under this contract and shall continue such insurance in full force and effect during the term of this contract. Failure to provide and continue in force such insurance as aforesaid shall be deemed a material breach of this contract and shall operate as an immediate termination hereof. The Contractor shall, without limiting the generality of the foregoing, conform to the provisions of section 34A of chapter 149 of the General Laws, which section is incorporated herein by reference and made a part hereof.

ARTICLE 17

The Contractor shall comply with the provisions of chapter 41 of the Revised Ordinances of 1947 of the City of Boston, sections 11 to 14, inclusive, hereinafter quoted, and any violation of the terms of said ordinance on the part of the Contractor or subcontractor shall prevent said Contractor or subcontractor from recovering either against the City or any other person, provided a breach of the ordinance has been established.

SECTION 11. No contract shall be made by the city except with —

(a.) individual citizens of the United States;

(b.) corporations or other legal associations wherein the controlling interest to the extent of at least over one half thereof is owned by a citizen or citizens of the United States.

Ordinances as
to contractors,
subcontractors
and their
employees.

SECTION 12. No person other than a citizen of the United States shall be employed on any public work being done by —

- (a.) the city of Boston;
- (b.) any contractor with the city of Boston;
- (c.) any subcontractor with such contractor; except that persons not such citizens may be employed in the manner and under the conditions set forth in the following section.

SECTION 13. Whenever no citizens of the United States competent to perform the work in question can be had at the prevailing customary rate of wages, the head of the department having charge of the work in question, with the written approval of the mayor, may issue a written authorization for the employment of such number of persons other than citizens for such time as may be necessary to do the work, provided that no such authorization shall be issued except after compliance with the provisions of the following section.

SECTION 14. Before issuing the written authorization provided for in the preceding section, the head of the department having charge of the work or contract shall give one or more public hearings and shall satisfy himself and certify in writing that the facts exist which warrant the issuance of such authorization. Where the employment is to be by a contractor or subcontractor he shall require a written statement from such contractor or subcontractor to such facts, sworn to before a justice of the peace.

ARTICLE 18

Removal of defective or unauthorized work.

All defective work shall be removed, repaired or made good, notwithstanding that such work has previously been inspected and approved or estimated for payment. If the work or any part thereof shall be found defective at any time before the final acceptance of the whole work, the Contractor shall at his own expense make good such defect in a satisfactory manner.

Any work done beyond the lines and grades shown on the plans or as given by the Commissioner or his assistants or any extra work done without written authority, shall be considered as unauthorized and at the expense of the Contractor. Such work will not be measured nor compensation allowed therefor. Work so done may be ordered removed at the Contractor's expense.

Upon failure of the Contractor to remove and satisfactorily dispose of any or all defective or unauthorized work, and to remedy the same after being so notified, the Commissioner may cause such defective work to be remedied, removed and replaced, and such unauthorized work to be removed; and to deduct the costs therefor, from any monies due or to become due the Contractor.

ARTICLE 19

Work not done properly may be redone or the remaining work be completed by City.

The City — if the Contractor at any time is not carrying on the work to the satisfaction of the Commissioner, or is not observing any other of the provisions of the contract, or has abandoned the work, or become insolvent or assigned his property — acting by the Commissioner and at his discretion, may terminate the contract and also may with or without notice to the Contractor, or advertising for doing the work, and by contract, day labor, or otherwise, use any materials, implements or machinery on or about the work or otherwise, and do any part of the work which the Contractor has failed to do, or replace any part not done to the satisfaction of the Commissioner, or take possession of the work and complete the same.

ARTICLE 20

Final inspection.

Before acceptance of the entire project, the Commissioner will make a complete final inspection of the work done.

If the work or any part thereof is not acceptable to the Commissioner at the time of the final inspection, he shall notify the Contractor in writing of the particular defect or parts to be remedied before final acceptance. If the Contractor has not arranged within a period of five (5) days after the date of transmittal of such notice of non-acceptability, to complete the work speedily as described by the Commissioner, the Commissioner may without further notice and without in any way affecting the contract, make such other arrangements as he may consider necessary to insure the satisfactory completion of the project. The cost of so completing the work shall be deducted from any payments due or which may become due the Contractor under the contract.

If the work is acceptable to the Commissioner, he will notify the Contractor to that effect and the date of the notification shall be considered as the date of acceptance and completion of the work.

ARTICLE 21

The City, by the Commissioner, after each month during which the Contractor shall have carried on the work prior to the month of the completion thereof, shall estimate and allow the value of materials owned and placed in permanent position on the work by the Contractor to the date of the estimate, and the value of the labor done on the work by him; shall deduct for the final settlement under the contracts (1) such sum as the Commissioner shall direct, not exceeding ten (10) per cent of the estimate, (2) such other sum as the Commissioner shall direct, not exceeding the total amount determined by the Commission to be the expense, loss and damage of the City caused by the termination of the contract as aforesaid or by failure of the Contractor as determined by the Commissioner, to conform to and carry out the provisions of the contract, (3) shall deduct all sums paid for carrying on the contract, and (4) shall deduct and retain, until the Commissioner shall request the payment thereof, such sum as he shall direct as being required to settle claims against the city, its agents or employees, relating to the contract.

Monthly allowance.

Deductions, 10 per cent of estimate.

ARTICLE 22

In preparing, within the sixty-five (65) day period required under Section 39G of Chapter 30 of the General Laws the final estimate of the quantity of work done under this contract and the value of such work or any semifinal estimate of such quantity and value, the Commissioner shall include, subject to the provisions of Article 5 the cost of extra work performed under orders made, given and paid for as authorized in Articles 2 and 3, and the reasonable expense, injury and loss caused by conforming to all other orders so made and given or by anything for which as determined by the Commissioner the City is liable and no other provision is made in this Article, but no sum shall be allowed for loss of profits on work taken away. In so preparing such final estimate or semi-final estimate, the Commissioner shall mark for deduction and retention (1) such sum as the Commissioner shall determine to be the decrease in the total cost of the work caused by change or taking away of any part thereof, (2) such sums as the Commissioner shall determine to be the expense, loss and damage of the City caused by failure of the Contractor as determined by the Commissioner to conform to and carry out the provisions of this contract, (3) such sums as the Commissioner shall determine to be the expense, loss and damage of the City caused by the termination of this contract under Article 19, (4) such sums as the Commissioner shall determine to be just for each day any work done for the City either by this Contractor or by any other person, firm or corporation is delayed through fault of this Contractor, as determined by the Commissioner, and (5) such sums as the Commissioner shall determine are required for settling or securing the payment of claims against the City, its agents or employees, relating to this contract.

Semifinal and final estimates.

ARTICLE 23

Release by
Contractor on
acceptance of
final payment.

In consideration of the execution of this contract by the City, the Contractor agrees that simultaneously with the acceptance of what the City tenders as the final payment by it under this contract, he will execute and deliver to the City an instrument under seal releasing and forever discharging the City of and from any and all claims, demands and liabilities whatsoever of every name and nature, both at law and in equity, arising from, growing out of, or in any way connected with this contract, save only such claims, demands and liabilities as are expressly excepted in said instrument.

ARTICLE 24

Contractor not
liable for cer-
tain things
under Special
Conditions.

Notwithstanding anything to the contrary hereinbefore contained, it is expressly agreed that the City will not hold the Contractor liable for any loss, expense or damage incurred by the City on account of failure or omission of the Contractor to furnish or deliver any of the goods or materials called for in this contract, if such failure or omission shall have been caused by state of war, acts of enemies, embargoes, expropriation or confiscation of the facilities used by the Contractor or his supplier, for the production, manufacture, transportation, handling or delivery of said goods and materials or by compliance with any law, order or regulation of any federal, state or municipal governmental authority. Upon learning that any goods or materials cannot be furnished in compliance with the terms of this contract because of the reasons enumerated above, the Contractor shall forthwith notify the Commissioner in writing thereof, who may cancel the contract. In the event of such cancellation the City shall be under no further liability under this contract.

It is further agreed and understood by and between the parties hereto that in the event of the failure or omission of the Contractor to furnish or deliver goods or materials because of the reasons enumerated above that the Commissioner may order the Contractor to furnish other goods and materials as a substitute for those goods or materials no longer available. Quality and suitability of such goods and materials shall conform to the standard specifications for such substituted goods and materials on file at the office of the Commissioner.

If any adjustment in price is necessitated by the determination of the Commissioner to accept the substituted goods or materials, the Commissioner shall so notify the Contractor.

In the event that the adjustment in price as determined by the Commissioner is not accepted by the Contractor, the question shall become subject to arbitration.

The arbitrators shall be appointed as follows:

One designated by the Commissioner; one by the Contractor and a third appointed by the other two.

It is mutually agreed that the decision of the arbitrators shall be a condition precedent to any right of legal action that either party may have against the other.

The Contractor shall not cause a delay of the work during any arbitration proceeding.

The arbitrators shall fix their own compensation, unless otherwise provided by agreement, and shall assess the costs and charges of the proceeding equally upon both parties.

It is further understood by and between the parties hereto that all "critical materials", so called, which are needed in connection with the prosecution of this contract, shall be delivered to the site of the work or in transit before the start of any of the work required hereunder.

ARTICLE 25

This contract is subject to an appropriation being available therefor.

The total estimated cost of the work to be done under this contract is.....
.....(\$.....).

Signed this.....19
CITY OF BOSTON

By.....
Commissioner of Public Works.

.....
Contractor.

By.....

Address.....

Contract approved:

.....
Mayor.

Form of Contract and Bonds approved:

.....
Corporation Counsel.

MEETING OF BOARD OF DIRECTORS

.....19

At the meeting of the Directors of the.....

duly called and held at.....on the.....

day of.....19 at which a quorum was present and acting, it was

Voted, That.....of the

.....
 is hereby authorized and empowered to make, enter into, sign, seal, and deliver in behalf of this corporation a contract for.....
 with the City of Boston, and performance and payment bonds (each in the full amount of the contract) in connection with such contract.

I do hereby certify that the above is a true and correct copy of the record, that said vote has not been amended or repealed and is in full force and effect as of this date, and that.....

.....
 is the duly elected.....
 of this corporation.

Attest:

Clerk of the Corporation.

PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS:

That we,

....., as Principal, and

....., as Surety, are held

and firmly bound unto the City of Boston, Boston, Massachusetts, as Obligee, in the sum of.....

.....dollars (\$), well and truly to be paid, and for the payment of which we and each of us hereby bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

This Obligation Is Upon the Condition that if the person or persons designated in the contract annexed hereto as the contractor and all subcontractors under said contract shall faithfully perform everything required of them to be performed under Articles 13 and 14 of said contract and if said contractor and all subcontractors on the work under said contract shall pay for all labor performed or furnished and materials used or employed in the work under said contract, including lumber so employed which is not incorporated in such work and is not wholly or necessarily consumed or made so worthless as to lose its identity, but only to the extent of its purchase price less its fair salvage value, and including also any material specially fabricated at the order of the Contractor or subcontractor for use as a component part of the work under said contract so as to be unsuitable for use elsewhere, even though such material has not been delivered and incorporated into such work, but only to the extent of its purchase price less its fair salvage value and only to the extent that such specially fabricated material is in conformity with the contract, plans and specifications or any changes therein duly made; and shall pay all sums due for the rental or hire of vehicles, steam shovels, rollers propelled by steam or other power, concrete mixers, tools and other appliances and equipment employed in such work, and shall pay all sums due trustees or other persons authorized to collect such payments from the contractor or subcontractors, based upon the labor performed or furnished as aforesaid for a maximum of one hundred and twenty consecutive calendar days, for health and welfare plans and other fringe benefits which are payable in cash and provided for in collective bargaining agreements between organized labor and the Contractor or subcontractors, and if the contractor shall pay, or cause to be paid, all rental and transportation charges for the hire or use, in the carrying out of the work

under said contract, of dump trucks, whether such charges are incurred by the contractor, subcontractors or suppliers or transporters or material to be incorporated in such work, this obligation shall be null and void; otherwise it shall remain in full force and effect.

For Value Received, said surety company hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of said contract or to the work to be performed thereunder or the specifications accompanying the same shall in any wise affect its obligation on this bond, and does hereby waive notice of any such change, extension of time, alteration or addition to the terms of said contract or to the work or to the specifications.

In Witness Whereof, the parties hereto have signed, sealed and delivered this instrument at Boston, Massachusetts, this _____ day of _____ 19 ____.

.....
(Principal)

By

.....
(Surety)

By

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS:

That we,

....., as Principal, and

....., as Surety, are held

and firmly bound unto the City of Boston, Boston, Massachusetts, as Obligee, in the sum of

..... dollars (\$), well and truly to be paid, and for the payment of which we and each of us hereby bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

This Obligation Is Upon the Condition that if the person or persons designated in the contract annexed hereto as the contractor, and all subcontractors under said contract, shall faithfully furnish and perform everything required to be furnished and performed by them under the provisions of said contract exclusive of Articles 13 and 14 thereof, then this obligation shall be void; otherwise it shall remain in full force and effect.

For Value Received, said surety company hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of said contract or to the work to be performed thereunder or the specifications accompanying the same shall in any wise affect its obligation on this bond, and does hereby waive notice of any such change, extension of time, alteration or addition to the terms of said contract or to the work or to the specifications.

In Witness Whereof, the parties hereto have signed, sealed and delivered this instrument at Boston, Massachusetts, this day of 19.....

.....
(Principal)

By

.....
(Surety)

By

PART II

DEFINITIONS

Whenever in the contract, specifications or other contractual documents the following terms, abbreviations or pronouns in place of them, are used the intent and meaning shall be interpreted as follows:

A.A.S.H.O.	. . . . .	The American Association of State Highway Officials.
ADDENDA	. . . . .	Revisions of any of the Contract Documents mailed to Bidders prior to the opening of bids.
ADVERTISEMENT	. . . . .	The invitation for proposals published in the <i>City Record</i> , announcing the time and place for the opening of bids for work to be done.
A.S.T.M.	. . . . .	The American Society for Testing Materials.
BIDDER	. . . . .	Any individual, firm or corporation submitting a proposal for the work contemplated, acting directly or through a duly authorized representative.
CITY	. . . . .	The City of Boston.
COMMISSIONER	. . . . .	The Commissioner of Public Works, acting directly or through an authorized representative, such representative acting within the scope of the particular duties entrusted to him.
CONSTRUCTION ENGINEER	. . . . .	An assistant of the Commissioner assigned to the project to perform duties of an engineering nature including the furnishing of lines and grades, and the preparation of pay estimates.
CONTRACTOR	. . . . .	The other party to the contract, acting directly or through a duly authorized agent or employee.
DEPARTMENT	. . . . .	The Public Works Department of the City of Boston.
EXTRA WORK	. . . . .	Work or materials for which no price is contained in the proposal and which is deemed necessary for the proper completion of the project.
INSPECTOR	. . . . .	An assistant of the Commissioner assigned to the project to see that the work is done in accordance with the governing plans, specifications and amendments thereto.
MATERIAL	. . . . .	Any substance proposed to be used in connection with the construction of any roadway, or of a structure and/or their appurtenances.
PLANS	. . . . .	The contract drawings, Department Standards, Detail Sheets, or exact reproductions thereof, which show the location, character, dimension and details of the work, including any alterations thereof.
PROPOSAL	. . . . .	The written offer of the Bidder to perform the work contemplated, submitted on approved forms furnished by the Department.
REFERENCES	. . . . .	Where reference is made in the Contractual Documents to Publications and Standards, issued by Associations or Societies, the intent shall be to specify the current edition of such Publication or Standards (including tentative revisions) in effect on the date of the contract advertisement, notwithstanding any reference to a particular date.

SPECIAL PROVISIONS	The special directions, provisions and requirements prepared to cover proposed work not satisfactorily provided for by the standard specifications. These special provisions shall be included within the general term "Specifications" and shall be considered as part of the contract with the express purpose that they shall prevail over all other specifications.
SPECIFICATIONS	The directions, provisions and requirements contained herein, designated as Standard Specifications, the Special Provisions, or any Addenda which may be issued, together with all written agreements made or to be made pertaining to the method and manner of performing the work, or the quantities and qualities of materials to be furnished under the contract.
WORK	All performance, including the furnishing of materials, labor, tools, equipment and incidentals, required of the Contractor under the terms of the contract.
THE WORDS	"As directed," "as permitted," "as required" or words of like effect shall mean that the direction, permission or requirement of the Commissioner is intended, and similarly the words "approved," "acceptable," "satisfactory," or words of like import shall mean approved by or acceptable or satisfactory to the Commissioner unless otherwise provided herein. The words "necessary," "suitable," "equal," or words of like import shall mean necessary, suitable or equal in the opinion of the Commissioner. The words "complete in place" shall mean the inclusion of all work, including incidentals mentioned or implied in the specifications and on the plans, or work that may reasonably be inferred as necessary to the proper execution of the item, unless payment for any portion of the work is specifically provided for otherwise.

PART III

GENERAL REQUIREMENTS

Specifications, etc., to be carefully studied.

Special directions and drawings to be obtained.

Specifications, etc., to be compared and conformed to if clear; information to be obtained if they are not clear.

Work to be commenced and pushed, notice to be given, etc.

Information and vouchers to be furnished.

Lines, etc., to be maintained; work to be protected.

Injuries, etc., to be immediately corrected.

IN GENERAL. — (a.) Carefully study these specifications, the plans for the work in the office of the Commissioner and the orders that shall be made and given as authorized in Articles 2 and 3 of the contract and procure from the Commissioner — information relative to borings when taken, samples of which will be kept in the office of the Commissioner — special information as to any part of the work not fully shown by specifications, plans or orders — detail drawings of such parts as detail drawings are provided for and — directions as to the order and manner of doing the work.

(b.) Carefully compare all said specifications, plans, orders and drawings, all figures, dimensions, lines, marks and scales thereof, and all directions of the Commissioner or his assistants relating to the work, and conform to those in relation to which there shall be no doubt or discrepancy, but at once submit all cases of doubt or discrepancy to the Commissioner for adjustment; anything done on any part of the work for which special information or detail drawing is to be procured, as aforesaid, except in accordance with such information or drawing, or done on any part in relation to which there shall be doubt or discrepancy except in accordance with the adjustment thereof, or done in violation of law or public authority, is to be redone, if the Commissioner shall so direct.

(c.) Commence the work forthwith, give all notices, take out all permits, pay all charges, fees, water and other rates therefor, give personal supervision thereto, keep a competent foreman and sufficient competent employees thereon skilled in the several parts which are given them to do, carry on the work with all proper speed and in accordance with the requirement of law and all other public authorities and to the satisfaction of the Commissioner, and furnish him with such information and vouchers relating to the work, the materials therefor and the persons employed thereon as are called for in the contract or as he shall from time to time request.

NOTE. — Proper speed means to carry on work from start to finish in a reasonably continuous operation at the very least inconvenience to the public. Any undue delay in progress of work under this contract will be deemed to be a breach of contract.

(d.) Furnish such boards and stakes and cause to be placed thereon, so as to be easily read, such lines, marks and directions relating to the work as the Commissioner or his assistants shall from time to time direct, and if any thereof is removed or cannot easily be read, replace it; support and protect from injury all existing gas pipes, water pipes, sewers, drains or other structures which are uncovered by the excavation, and shall restore them, if injured or removed, free of cost, to a condition equal to that in which they were found; prevent, by sheeting and shoring, if necessary, any caving, or bulging of the sides of any excavation made by the Contractor; leave sheeting and shoring in place, if, and as, directed by the Commissioner; and if any is removed, fill solid the spaces left thereby; take care of all water and of whatever flows in any conduit interfered with by the Contractor, so that no puddle or nuisance will be caused by water or flow; protect everything from injury by water, frost, wind, fire, accident, or other cause, and from any interference; repair any injury, defect, omission or mistake in the work as soon as it is discovered; complete and leave the work in perfect condition and finish and immediately make good any defect, omission or mistake remaining therein even if the work has been left, and in case of the Contractor's default the Commissioner shall have power to make good at the Contractor's expense.

(CHAPTER 431)

AN ACT TO REQUIRE CITIES AND TOWNS TO SHORE TRENCHES ON CONSTRUCTION PROJECTS

Be it enacted, etc., as follows:

Chapter 149 of the General Laws is hereby amended by striking out section 129A, inserted by chapter 305 of the acts of 1949, and inserting in place thereof the following section: — Sec. 129A. On any construction project carried on by any city, town, county or other subdivision of the commonwealth in which a trench is to be dug to a depth of five feet or more, except a trench for laying of water pipes dug to a depth of six and one-half feet which will be open less than forty-eight hours, such trench shall be shored and braced in conformity with the rules and regulations for the prevention of accidents in construction operations, as adopted and enforced by the department. This section shall not apply to the digging of graves. *[Approved June 7, 1956]*

(e.) Take charge of, and be liable for, any loss of, or injury to, the materials for the use of the Contractor, delivered at, or in the vicinity of, the place where the work is being done, whether furnished by the City or otherwise; notify the Commissioner as soon as any such materials are so delivered, allow them to be examined by the Commissioner or an assistant, and furnish men to assist therein; promptly remove from said place and its vicinity, to such places as shall be designated by the Commissioner, such materials, refuse and rubbish, to be the property of the City, as shall be designated by the Commissioner; convey, at the Contractor's own expense, the materials furnished by the City from the storage place of the City to his work as rapidly as the progress of the work demands. The Contractor shall be responsible for loss incurred or damage done to materials furnished by the City from the time of their delivery to him at the storage place until the work is accepted by the City.

(f.) Conduct the work in such manner as not to interfere with other work being done for the City, by contract or otherwise, and if deemed necessary by the Commissioner the work done under this contract shall conform to the progress of said other work. Co-operate with other contractors or employees who may be doing work for the City, and with public service corporations affected by the work, in arranging for storage places, temporary support for structures, repairs, etc.

Where pipes, conduits or appurtenances belonging to the City, a town, the states, or public service corporations, may be found across, alongside or within the excavations, the Contractor shall support the same in a manner satisfactory to the Commissioner, including all incidental work.

Water Service pipes in all excavations shall be properly supported on the underside by two (2) inch planks, left in place.

(g.) Assume all responsibilities of the work and take all proper precautions to protect property from injury or unnecessary interference or inconvenience; provide proper means of access to property where the existing access is cut off by the Contractor and replace or put in good condition every public or private way, conduit, catch basin, tree, fence, or other thing injured by the Contractor in carrying on the contract, unless the same has been permanently done away with on approval of the Commissioner as being necessary for the proper carrying on of the contract.

(h.) Take all proper precautions to protect persons from injury, unnecessary interference or inconvenience; leave an unobstructed way along public and private places for travelers, street cars and vehicles, and for access to hydrants and gates; provide proper walks and bridges over or around any obstruction made in a public or private place in carrying on the contract; provide all necessary watchmen, and maintain from the beginning of twilight, through the whole of every night, on or near the obstruction, sufficient lights and guards to protect travelers from injury thereby; it being understood that the Contractor shall light the outside of the engineers' and inspectors' offices at his expense; and do such watering and

sprinkling as may be necessary to prevent dust nuisance; when the work is suspended put all roadways and sidewalks in proper condition and when the work is completed put the place and its vicinity in proper condition and leave them.

The Contractor shall construct bridges at such places as may be necessary in order to carry out the provisions of this contract, the surface of the bridges being flush with the surface of the street. The Contractor shall also construct bridges at all driveways and maintain such bridges in such manner as to assure safe transit of vehicles at all times. The bridges shall be capable of supporting at any point an H₂O loading.

(i.) In all the operations connected with the work herein specified, all City Ordinances, and all laws controlling or limiting in any way the actions of those engaged in the work, or the method, or materials to be used, must be respected and strictly complied with.

If any person employed on the work by the Contractor be disobedient, or appears to the Commissioner to be incompetent, unfaithful or disorderly, he shall be discharged immediately on the requisition of the Commissioner and shall not be again employed on the work.

(j.) Furnish and maintain from the beginning of twilight, through the whole of every night, suitable lights at or near every traffic or detour sign necessitated by the work, including those erected by the Traffic Commission of the City of Boston.

(k.) All materials and workmanship, and the manner and method of doing the work, are to be to the complete satisfaction of the Commissioner.

(l.) All materials, unless otherwise specified, shall be new, of first-class quality, and shall strictly conform to the Standard Specifications of the American Society for Testing Materials current specifications as amended to date for the respective materials.

(m.) After the contract has been approved by the Mayor and after the Contractor and the Commissioner or his assistants have agreed upon a starting date that will insure a reasonably continuous progress of the work, the Commissioner will send the Contractor a written order to commence the work. The work is not to be started without this order and the work is to be completed on or before the time named in the Proposal.

If the Contractor is unable to complete the work called for by this contract on the date or within the time specified herein, he shall request the Commissioner, in writing, for an extension of time, not later than one (1) month before the time for completion has elapsed, and the Commissioner may, at his discretion, grant such extension.

PART IV

STANDARD SPECIFICATIONS

OF

HIGHWAY DIVISION

GENERAL PROVISIONS OF HIGHWAY DIVISION

(a.) Furnishing and laying of the various roadway and sidewalk materials shall include the connecting, by grades given by the Commissioner or his assistants, each street under the contract with all adjoining streets; setting aside and using on the work such materials as shall be approved by the Commissioner or his assistant; performing all handling, hauling, cutting, fitting, pointing, jointing, screening and other things required for examining, preparing and using the materials whether furnished by the City or otherwise; except as otherwise clearly provided in these specifications, furnish and do to the satisfaction of the Commissioner everything required for the above.

(b.) Repair any settlement or other defect appearing within five years after the completion of the work in the street in which the work is done, or, if the repairs are not made within five days after the defect appears, pay to the City the amount determined by the Commissioner to have been incurred by the City in making the repairs.

(c.) Keep all new roadway and sidewalk work done under this contract in good condition satisfactory to the Commissioner, for a period of five years from the date of the completion and acceptance thereof.

(d.) The stakes and pins showing lines or grades are to be placed by the Commissioner or his assistant, and are to be furnished, protected and kept in place by the Contractor, who is to report to the Commissioner or his assistant when any doubt exists as to the correctness of any stake; is not to proceed with the work until the Commissioner or his assistant certifies to such correctness, and is to be responsible for any defective work caused by any disturbance thereof.

(e.) **PROCEDURE.**—In order to cause the least possible inconvenience in the district, the following procedure shall be used in reconstruction of existing paved streets:

First.—Where directed, edgestone must be reset to its proper grade in its entirety.

Second.—Where directed, new artificial stone sidewalk must be laid in its entirety.

Third.—Where directed, concrete base in roadway for edgestone trench shall be laid.

Fourth.—After above conditions have been met roadway shall be resurfaced in usual manner.

(f.) **MATERIALS.**—All materials necessary to perform the work under this contract are to be furnished by the Contractor unless specifically noted otherwise.

Street signs shall be furnished by the City at Paving District No. 10.

(g.) NOTICE TO CONTRACTOR.—To enable the City to furnish inspectors at plants at the necessary time, when the Contractor desires delivery of concrete or bituminous materials, he shall notify the Finals Engineer of the Department to this effect by no later than 4 P.M. of the previous working day. (If material is desired on a Monday the notification shall be before 4 P.M. on the previous Friday.)

Concrete or bituminous material will not be accepted on the job without an inspection slip furnished by the inspector at the plant.

(h.) All the foregoing work is to be done; all materials necessary for doing the work, and all the materials not specified as being furnished by the City are to be furnished by the Contractor at his own expense and the price to be paid for them is to be included in and be a part of the price bid for doing the work under the several Items of this contract.

(i.) A copy of all delivery slips of all materials delivered on the work must be given to the inspector who must sign and retain the copy for the records of the City of Boston.

SECTION A

CONSTRUCTION DETAILS

EXCAVATION, GRADING AND FILLING

A1 — REMOVING TREES, STUMPS, ETC.

GENERAL

This Item shall include the removal and satisfactory disposal of trees, including the stumps and roots thereof, or existing stumps, where designated by the Commissioner.

MEASUREMENT AND PAYMENT

Only such trees as have a shortest diameter of four (4) inches or over, measured three (3) feet above the ground shall be included in this Item, and only such stumps as have a diameter of nine (9) inches or over shall be included in this Item. The removal of trees under four (4) inches and stumps under nine (9) inches shall be included as incidental work in the price bid under Item A2-1 of the contract.

Where the tree consists of a single trunk extending more than a 3-foot vertical height above the average natural ground line, the shortest diameter shall be measured at the 3-foot level above the average elevation of the original ground.

Any tree whose main trunk separates into multiple trunks or which has limbs or branches growing out from the main trunk below the 3-foot level defined hereinbefore shall have its shortest diameter measured at the lowest point on the main trunk where multiple growth or branching out begins, provided that at least one of the trunks, limbs or branches has a measured shortest diameter of at least 4 inches at the specified 3-foot level.

The removal of trees and stumps will be paid for at the contract unit price each for Trees or Stumps Removed. The removal of trees under four (4) inches and stumps under nine (9) inches shall be included in the price bid under Item A2-1 of the contract.

PAYMENT ITEMS

A1-1 — Trees Removed (4"-12").....	Each
A1-2 — Trees Removed (over 12"-24").....	Each
A1-3 — Trees Removed (over 24").....	Each
A1-4 — Stumps Removed (9" or more).....	Each

A2-1 — EXCAVATION AND FILLING

GENERAL

The subgrades for the edgestones, roadway and sidewalks shall be carefully prepared. Where directed, the existing edgestones, cobblestones, paving blocks, fences, hedges and shrubs, bituminous, concrete, reinforced concrete and macadam pavements, crosswalks, bricks, defective artificial stone, reinforced artificial stone and bituminous sidewalks, telford, concrete and reinforced concrete base, all soft, loose or broken rock, and all spongy, vegetable and other objectionable and surplus materials are to be removed and the existing surface is to be brought by excavating or filling to the proper subgrades as hereinafter specified.

NOTE.—Prior to the removal of any existing fences, hedges or shrubs which are the property of the abutters, the Contractor shall obtain the consent of the abutters, for their careful removal and placing on abuttor's property.

The telford, macadam and concrete base shall be included in Item A2-1 when a mechanical shovel is used.

NOTE.—All excavation will be paid for under Item A2-1 unless a special provision is inserted in the contract directing that the excavation for certain areas be paid for under another Item or Items; or except where the excavation is described, and payment provided for, under other Items in the contract.

The subgrades when used in connection with a concrete or bituminous concrete or macadam or gravel base or Portland cement concrete pavement, after being so excavated or filled, shall be made solid, compact and of even surface with a steam roller (or gas roller) weighing at least twelve (12) tons or, in the parts which cannot be reached with rollers, with rammers.

When filling is needed on other streets in the contract, the surplus materials are to be hauled to the other streets, provided they are suitable. All filling used is to be deposited in horizontal layers, each layer not exceeding six (6) inches in thickness and each layer is to be thoroughly watered and rolled or rammed as hereinbefore provided; and if any subgrade, before the work is completed, shall, from rolling, ramming, shrinkage, removal of materials or other cause, fall in any part below the proper subgrade, such part is to be filled with good, clean gravel and thoroughly rammed, after which the whole of the subgrade is to be thoroughly rolled or rammed, as aforesaid, to the proper subgrade.

A2-2 — EXCAVATION FOR SERVICES

Excavation necessary for adjustment of sewer and water services and excavation for relocating hydrants shall conform to all the applicable requirements of Item A2-1, and will be paid for under Item A2-2.

Excavation necessary for the adjustment of castings as described in Section D-1 will not be paid for under this Item, but shall be included in the price bid under Item D1-3.

MEASUREMENT AND PAYMENT

Excavation for subgrading and services will be measured in place before excavation by the cross-section method except that where this method is impracticable the volume shall be measured by such other methods as the Commissioner may determine.

Excavation will be paid for at the contract unit price per cubic yard, which price shall include all backfilling, when materials are obtained from excavation, all grading and rolling to prepare sub-grade and disposal of surplus material.

When filling is needed on other streets in the contract, the surplus materials shall be hauled to the other streets, provided they are suitable. This is to be included in the price bid for Item A2-1.

The telford, macadam and concrete base shall be paid under Item A2-1 when removed by a mechanical shovel.

Where granite blocks (cement grout joints), bituminous concrete or asphalt is stripped as a top pavement in a street with a paved base, this shall be paid under Item A2-5.

PAYMENT ITEMS

A2-1 — Excavation for Subgrading.....Cubic Yards

A2-2 — Excavation for Services.....Cubic Yards

A2-3 — ROCK AND WALL EXCAVATION

Rock excavation shall include only such rock as requires blasting for its removal; and reinforced concrete walls, brick walls and granite masonry walls and any other brick or granite masonry measuring one cubic yard or more which require blasting or compressed air for their removal will also be included in the Item for Rock and Wall Excavation.

Boulders measuring one cubic yard or more which do not require blasting or compressed air for their removal will also be included in the Item for rock and wall excavation, and will be measured by the Commissioner's assistants at the point of removal.

MEASUREMENT AND PAYMENT

Rock will be measured in place before excavation by the cross-section method except that where this method is impractical the volume shall be measured by such other methods as the Commissioner may determine.

Rock or wall that requires blasting or compressed air for its removal shall be measured up to a maximum of 6 inches below subgrade and up to a maximum of 12 inches beyond street line.

Rock excavation will be paid for at the contract unit price per cubic yard.

Rock excavation *in trench* will be paid for under Item A4-1.

PAYMENT ITEM

A2-3 — Rock and Wall Excavation.....Cubic Yards

A2-4 — EXISTING CONCRETE, REINFORCED CONCRETE OR MACADAM BASE REMOVED

Existing concrete, reinforced concrete or macadam base shall be removed, where necessary, in the setting and resetting of edgstones and elsewhere as may be directed.

A2-5 — EXISTING PAVEMENT REMOVED

The existing macadam, bituminous, sheet asphalt, granite block or reinforced concrete pavement shall be removed where necessary, in the setting and resetting of edgestone and elsewhere as may be directed.

NOTE.— Mechanical rammers, steel balls or any similar devices will not be permitted in connection with the removal of granite blocks or concrete pavements.

MEASUREMENT AND PAYMENT

Existing concrete, reinforced concrete or macadam base removed; and macadam, bituminous, sheet asphalt, granite block or reinforced concrete pavement removed; will be measurement of actual area removed.

Existing concrete, reinforced concrete or macadam base removed; and macadam, bituminous, sheet asphalt, granite block or reinforced concrete pavement removed; will be paid for at the contract unit price per square yard.

Under these Items the construction name of the existing pavement will govern the depth to be removed except bituminous concrete and asphalt pavements which will be paid as one pavement regardless of the depth.

The unit price shall include the disposal of all material removed, and proper grading of the subgrade — and where pavement is removed from concrete base, cleaning and brooming of the base.

PAYMENT ITEMS

A2-4 — Existing Base Removed.....Square Yard

A2-5 — Existing Pavement Removed.....Square Yard

A3-1 — BANK GRAVEL

GENERAL

Gravel used for edgestone foundation shall be four (4) inches thick, unless otherwise directed.

Upon the properly prepared subgrade shall be laid a gravel base which, after rolling in the roadway area, shall be as thick as directed in the Special Provisions.

CONSTRUCTION METHODS

Bank gravel shall be used to a depth as directed for the foundation of edgestones and roadway pavements. This gravel shall consist of hard, durable stone and coarse sand practically free from loam and clay, uniformly graded and containing no stone having any dimension greater than six (6) inches. The gravel shall be spread from self-spreading vehicles or with power graders of approved types or by hand upon the prepared subgrade or subbase. All gravel used is to be deposited in horizontal layers, each layer not exceeding six (6) inches in thickness and each layer is to be thoroughly rolled and wa-

tered or rammed. Care shall be taken while spreading the gravel to rake forward and distribute the largest stones so that they will be at the bottom of the gravel course and be evenly distributed. The gravel so placed shall be thoroughly rolled, true to lines and grades as directed, with a self-propelled roller weighing not less than twelve (12) tons. Any depressions that appear during or after the rolling shall be filled with gravel and re-rolled until the surface is true and even. The gravel shall conform to the following requirements:

Passing $\frac{1}{2}$ " sieve	70% maximum
Passing No. 4 sieve	50% maximum
Passing No. 200 sieve	5% maximum

MEASUREMENT AND PAYMENT

The bank gravel will be paid for on the basis of weight as certified to, by a public weigher or by a representative of the Department, subject to the following restrictions. If the Commissioner determines that the Contractor is unable to make reasonable arrangements for the weighing of the gravel by a certified weigher, the weight of the gravel will be determined by the City on the basis of 3,300 pounds of gravel per cubic yard compacted in place. The Department will determine the volume of gravel by the cross-section method or by actual tests of depths, or by a combination of both methods. The Department will then use the above-referenced 3,300 pounds as a conversion factor in determining the weight of gravel furnished.

The Contractor will be paid for all gravel delivered and placed in the roadway area up to a maximum of two (2) inches deeper than the specified depth. The City will not pay for any gravel furnished by the Contractor in excess of the specified depth plus the above referenced tolerance of two (2) inches, except where poor soil below subgrade is removed and replaced with new gravel, in which case, the Contractor will be paid for the amount of gravel used.

All gravel furnished for foundations for edgestones and sidewalks will be paid on the basis of the weight of material delivered up to a maximum of the depths and widths as specified, except where poor soil below subgrade is removed and replaced with gravel, in which case, the Contractor will be paid for the amount of gravel used.

PAYMENT ITEM

A3-1 — Bank Gravel.....Tons

A3-2 — CRUSHED STONE

Crushed stone for the foundation of edgestones shall consist of clean, durable crushed rock consisting of the angular fragments obtained by breaking and crushing solid or shattered natural rock and shall be graded to meet requirements for No. 2 stone defined in Section C-2. Pea stone may be used for tamping edgestone to the final grade.

Upon the properly prepared gravel base a two (2) inch layer of No. 2 crushed stone shall be spread, rolled and bound with three-eighths ($\frac{3}{8}$) inch pea stone. After rolling, the macadam subbase course shall be inches below and parallel to the finished grade of the roadway. (See Special Provisions.)

MEASUREMENT AND PAYMENT

Crushed stone shall be measured by tickets delivered with each load. These tickets shall be signed by a certified sworn weigher and counter-signed by a City Inspector. Tolerance not to exceed 20 per cent of Calculated Volume, based on 3,500 pounds per cubic yard.

The Contractor will be paid for all crushed stone delivered and placed in the roadway area and edgestone foundation, and will not be paid for any crushed stone in excess of the specified depths plus the above referenced tolerance.

PAYMENT ITEM

A3-2 — Crushed Stone.....Tons

A4-1 — TRENCH ROCK EXCAVATION

Trench Rock Excavation shall include the removal and satisfactory disposal of all rock that requires blasting for its removal or if blasting is not acceptable any rock which requires power tools for breaking it up prior to removal, and boulders of one (1) cubic yard or more in volume, encountered in trenches, and excavation for catch basins, manholes, hydrants, drains and similar services.

MEASUREMENT AND PAYMENT

Only such rock or boulders encountered within the limits of standard trench widths and from elevations 6 inches below subgrade will be measured and paid for at the contract unit price per cubic yard.

PAYMENT ITEM

A4-1 — Trench Rock Excavation.....Cubic Yards

A5-1 — HOUSE DRAIN CONNECTIONS

The work to be done under this Item consists of furnishing all labor, material and equipment for furnishing and laying, or relaying house drains or their connections, including calking joints, all in accordance with the applicable specifications of the City of Boston Sewer Division.

Excavation and backfill in connection with this Item will be paid for under Item A2-2, Excavation for Services.

PAYMENT ITEM

A5-1 — House Drain Connections (furnished and laid, or relaid).....Linear Foot

SECTION B

CURB AND EDGING

B1-1, 2, 3 — NEW EDGESTONE

GENERAL

The work to be done hereunder consists of furnishing and setting new granite edgestone on gravel or crushed stone foundations and to the required line and grade as indicated on the plans and as directed, in accordance with these specifications.

MATERIALS

Edgestone shall be of hard and durable granite, of a uniformly light, grayish white color satisfactory to the Commissioner, free from seams and other structural imperfections, and of a good smooth splitting appearance. Granite shall be from approved quarries and, when tested, shall have a French coefficient of wear not less than 16 or a Los Angeles percentage of wear not more than 32.

The edgestones for the several types of curb shall be cut to the dimensions given in the following table:

Type	Min. Length	Width at Top	Depth	Minimum Width at Bottom
VA1	6 feet	7 inches	17 to 19 inches	4 inches (for 2/3 length)
VA2	6 feet	7 inches	19 to 21 inches	4 inches (for 2/3 length)
VA3	6 feet	6 inches	19 to 21 inches	4 inches (for 2/3 length)
VA4	6 feet	6 inches	17 to 19 inches	4 inches (for 2/3 length)
VB	3 feet	5 inches	15 to 17 inches	3½ inches (for 2/3 length)
VC	3 feet	4½ to 5½ inches	14 to 18 inches	3 inches (for 1/2 length)
VD	1 foot	3 to 5 inches	14 to 18 inches	2 inches (for 1/2 length)

Type VA edgestones to be set on a radius of one hundred fifty (150) feet or less shall be cut to the curve required, unless otherwise directed by the Commissioner.

Type VB or VC edgestones to be set on a radius of one hundred (100) feet or less shall be cut to the curve required, unless otherwise directed by the Commissioner.

All type VD edgestones shall be cut straight.

The finish and surface dimensions for the several types of edgestone shall conform to the following requirements:

A. TYPE VA CURB.—This type of edgestone shall have a top surface free from wind, shall be peen hammered or sawed to an approximate true plane, and shall have no projections or depressions greater than one-eighth ($\frac{1}{8}$) of an inch. The front and back arris lines shall be pitched straight and true and there shall be no projection on the back face for three (3) inches down from the top which would exceed a batter of four (4) inches in one (1) foot.

The front face shall be at right angles to the planes of the top and ends and shall be smoothly quarry split, free from drill holes and with no projection of more than one (1) inch and no depression of more than one-half ($\frac{1}{2}$) inch measured from the vertical plane of the face through the arris or pitch line for a distance down from the top of eight (8) inches for Type VA1 and VA4 and ten (10) inches for VA2 and VA3. For the remaining distance there shall be no projection or depression greater than one (1) inch measured in the same manner.

The ends of all stones shall be square with the planes of the top and face so that when the stones are placed end to end as closely as possible no space shall show in the joint at the top and face of more than three-eighths ($\frac{3}{8}$) inch for the full width of the top and for eight (8) inches down on the face for Type VA1 and VA4 and ten (10) inches for VA2 and VA3, after which the end may break back not over eight (8) inches from the plane of the joint. The arris formed by the intersection of the plane of the joint with the planes of the top and exposed face shall have no variation from the plane of the top and exposed face greater than one-eighth ($\frac{1}{8}$) of an inch.

If sawed, the edgestone shall be thoroughly cleaned of any iron rust or iron particles by sand blasting or other approved methods satisfactory to the Commissioner, and any conspicuous saw marks shall be removed with a peen hammer.

B. TYPE VB CURB.—This type of edgestone shall have a top surface free from wind, shall be pointed, peen hammered or sawed to an approximately true plane and shall have no projections or depressions greater than one-quarter ($\frac{1}{4}$) of an inch. The front and back arris lines shall be pitched straight and true.

The front face shall be at the right angles to the plane of the top, and shall be smooth quarry split, free from drill holes and with no projection of more than one and one-half ($1\frac{1}{2}$) inches and no depression greater than one (1) inch measured from the vertical plane of the face through the arris or pitch lines for the full depth of the face.

The ends of all stones shall be square with the planes of the top and face so that when stones are placed end to end as closely as possible, no space shall show in the joint in the top and face of more than three-eighths ($\frac{3}{8}$) of an inch for the full width of the top and eight (8) inches down on the face after which the ends may break back not more than one (1) foot from the plane of the joint. On pieces less than four (4) feet in length, the ends shall not break back more than nine (9) inches. The arris formed by the intersection of the plane of the joint with the planes of the top and exposed face shall have no variation from the plane of the top and exposed face greater than one-eighth ($\frac{1}{8}$) of an inch.

If sawed, the edgestones shall be thoroughly cleaned of any iron rust or iron particles by sand blasting or other approved methods satisfactory to the Engineer, and any conspicuous saw marks shall be removed with a peen hammer.

C. TYPE VC CURB.—This type of edgestone shall have a top surface free from drill holes for at least two (2) inches back from the face, and shall be scabble dressed to an approximately true plane with no projections or depressions greater than one-half ($\frac{1}{2}$) inch. The arris at the intersection at the top and face shall be pitched straight and true so that when a straight edge is applied to the full length of the curb stone, there shall be no depressions under the straight edge greater than one-half ($\frac{1}{2}$) inch.

The front face shall be at right angles to the plane of the top and shall be smooth quarry split, free from drill holes which are longer than three and one-half ($3\frac{1}{2}$) inches and deeper than one-half ($\frac{1}{2}$) inch, and with no projection of more than three-quarters ($\frac{3}{4}$) of an inch and no depression of more than one-half ($\frac{1}{2}$) inch measured from the vertical plane of the face through the arris or pitch line for eight (8) inches down from the top.

The ends of all stones shall be square with the planes of the face and top so that when stones are placed end to end as closely as possible, no space shall show in the joint at the top and face of over three-eighths ($\frac{3}{8}$) of an inch for eight (8) inches down on the face and the full width of the top, after which the end may break back not more than eight (8) inches. The arris formed by the intersection of the plane of the joint with the planes of the top and exposed face shall have no variations from the plane of the top and exposed face greater than one-quarter ($\frac{1}{4}$) of an inch.

D. TYPE VD CURB.—This type of edgestone shall have a top surface free from drill holes for at least two (2) inches back from the face, and shall be scabble dressed to an approximately true plane with no projections or depressions greater than one-quarter ($\frac{1}{4}$) of an inch. The arris at the intersec-

tion of the top and face shall be straight and true, so that when a straight edge the full length of the stone is applied thereto, there shall be no depression under the straight edge greater than one-half ($\frac{1}{2}$) inch.

The front face shall be at right angles to the plane of the top and shall be smooth quarry split, free from drill holes which are longer than three and one-half ($3\frac{1}{2}$) inches and deeper than one-half ($\frac{1}{2}$) inch, and with no projection or depression of more than one-half ($\frac{1}{2}$) inch measured from the vertical plane of the face through the arris or pitch line for eight (8) inches down from the top.

The ends of all stones shall be square with the planes of the face and top, so that when stones are placed end to end as closely as possible, no space will show in the joint of over three-eighths ($\frac{3}{8}$) of an inch for six (6) inches down on the face and the full width of the top, after which the end may break back not more than one-quarter ($\frac{1}{4}$) the length of the stone. The arris formed by the intersection of the plane of joint with the planes of the top and exposed face shall have no variation from the plane of the top and exposed face greater than one-quarter ($\frac{1}{4}$) of an inch.

CONSTRUCTION METHODS

Drawings of edgestones are on file in the office of the Commissioner.

SETTING OF NEW STRAIGHT, CIRCULAR, AND CORNER EDGESTONES ON GRAVEL FOUNDATION. — The foundation is to be made of gravel, to be furnished and paid for under Item A3-1, and consist of material as specified under Section A-3, Gravel. The trenches for the edgestone are to be eighteen (18) inches wide and the subgrade is to be twenty-three (23) inches below the top of the finished edgestone. Upon this subgrade a foundation is to be made of good, clean, coarse gravel, thoroughly rammed so it shall be at least four (4) inches thick and the full width of the trench when completed. Upon this foundation other gravel of the same kind is to be spread where necessary, the edgestone laid thereon, and thoroughly tamped so that the stone will bear throughout its whole length and be at the line and grade required.

SETTING OF NEW STRAIGHT, CIRCULAR, AND CORNER EDGESTONES ON CRUSHED STONE FOUNDATION. — The trench for the edgestone is to be eighteen (18) inches wide and the subgrade is to be twenty-five (25) inches below the top of the finished edgestone. Upon this subgrade a foundation is to be made consisting of good, clean, crushed stone to be paid for under Item A3-2 and consisting of material as specified under Section A-3. The foundation is to be made of good, clean, crushed stone, thoroughly rammed, so that it will be six (6) inches thick and the full width of the trench when completed. Upon this foundation other crushed stone is to be spread where necessary, the edgestone laid thereon, and thoroughly tamped so that the stone will bear throughout its whole length and be at the line and grade required. At each side of every catch basin an entrance is to be made and one length of four (4) inch glazed sewer pipe placed therein. The outer end of the pipe is to be closed with a screen of one quarter ($\frac{1}{4}$) inch mesh of heavy galvanized wire. The pipe is to be laid just below the edgestone trench and covered with crushed stone; the price to be paid is to be included in the price bid under Item B1-1 and B1-2. Where edgestones are to be laid on a crushed stone foundation a crushed stone foundation shall be laid across all driveways.

EDGESTONE JOINTS. — The joints of all edgestones set, reset or relocated are to be made as close as possible and no stone is to be butted unless both ends are at a right angle to the top of the edgestone for a distance of at least twelve (12) inches. The joints are to be filled with mortar composed of one (1) part Portland cement and two (2) parts clean sand, before backfilling is done.

MEASUREMENT AND PAYMENT

The amount of granite edgestone to be paid for will be the length actually laid in accordance with the plans or as directed by the Engineer as measured along the front arris line of the edgestone.

Granite edgestone will be paid for at the contract unit price per lineal foot under the Item for the particular type and kind of edgestone required, furnished and installed complete in place, which price shall include full compensation for all cutting necessary for driveways, etc., and materials used, except

that gravel or crushed stone for the foundation, as the case may be, will be paid for respectively under Items A3-1 and A3-2. Circular edgestone shall include all edgestone (except edgestone corners) cut and set to curves as directed. All types of straight edgestone that are used on curves shall be paid for as straight edgestone.

Roadway pavements and base removed in the setting of edgestone on gravel or crushed stone foundation will be paid for under Items A2-4 and A2-5.

PAYMENT ITEMS

B1-1 — New Straight Edgestone, Type ().....	Lineal Feet
B1-2 — New Circular Edgestone, Type ().....	Lineal Feet
51-3 — Edgestone Corners, Type ().....	Each

B2-1, 2, 3 — EXISTING EDGESTONE

RESETTING OF EXISTING EDGESTONE, CIRCLES AND CORNERS. — Where existing edgestones, circles or corners are required to be raised to line and grade, sufficient good, coarse, clean gravel shall be used and thoroughly rammed to bring it to proper line and grade. Where it is necessary to lower the grade of existing edgestones, the edgestone shall be removed, and a foundation is to be made of good, coarse, clean gravel and thoroughly rammed so that it will be four (4) inches thick and the full width of the trench when completed, and on this foundation the edgestone is to be reset to the proper line and grade. Edgestone joints shall conform to Section B-1.

In the resetting of edgestone the pavement and base shall be cut through, by the compressor method, for a distance not to exceed 18 inches from the face of the edgestone for the entire length of pavement and base removed.

MEASUREMENT AND PAYMENT

The quantity of edgestone to be paid for will be the length actually reset in accordance with the plans, or as directed by the Engineer, as measured along the top front edge of the edgestone reset.

Reset edgestone will be paid for at the contract unit price per lineal foot, which price shall include full compensation for all work necessary to complete the Item, including cutting of stone; but except that rock excavation, roadway pavement removed, and roadway base removed, will be paid for respectively under Items A2-3, A2-4 and A2-5.

PAYMENT ITEM

B2-1 — Existing Edgestone Reset.....	Lineal Feet
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EXISTING EDGESTONE REMOVED, RELOCATED AND RESET. The existing edgestone shall be removed, relocated and reset to new locations, where directed. The edgestone shall be set true to line and grade and in accordance with specifications for resetting edgestone on gravel or crushed stone foundation. Edgestone joints shall conform to Section B-1. Excavation of edgestone trench shall not exceed 18 inches beyond face of edgestone in roadway area.

MEASUREMENT AND PAYMENT

The quantity of edgestone to be paid for will be the length actually removed, relocated and reset, in accordance with plans or as directed by the Engineer, as measured along the top edge of the edgestone, reset in new location.

Existing edgestone removed, relocated and reset a minimum of one (1) foot from existing location will be paid for under the contract unit price, including labor and equipment, jointing of edgestone, cutting of stone and incidental work; except that gravel or crushed stone for the foundation, and roadway base and pavement removal, will be paid for as hereinbefore provided.

PAYMENT ITEMS

B2-2 — Edgestone Removed, Relocated and Reset Lineal Feet

B 2-3 — EXISTING EDGESTONE DISPOSED OF OR HAULED TO CITY YARD

All existing edgestone removed where directed which becomes surplus, but is in good condition, shall be hauled to the nearest City Yard and stored where directed. All existing edgestone removed where directed which becomes surplus, but is not in good condition shall be disposed of by the Contractor.

All pieces of edgestone returned to the City Yard must have a minimum length of four (4) feet.

MEASUREMENT AND PAYMENT

Edgestone hauled to the City Yard shall be actual measurement of stone delivered to the City Yard.

Edgestone disposed of by the Contractor shall be actual measurement of stone removed where directed by Engineer.

Existing edgestone hauled will be paid for at the contract unit price per lineal foot on the basis of stone delivered to City Yard and Contractor shall present at City Yard a material slip signed by Inspector on work under contract from which edgestone is removed and countersigned by City Foreman of yard at which stone is delivered, including excavation, labor and equipment, except pavement and base when not removed by a mechanical shovel.

Existing edgestone disposed of by the Contractor will be paid for at the contract price per lineal foot.

PAYMENT ITEMS

B2-3 — Existing Edgestone disposed of or hauled to City Yard Lineal Feet

B 3 — STANDARD GRANITE EDGING

MATERIALS

The edgestones shall be of hard and durable granite of a uniformly light, grayish white color and satisfactory to the Engineer, free from seams and other structural imperfections and of a good, smooth splitting appearance.

The stones for the several types of edging shall be cut to the dimensions given in the following table.

	Type SA	Type SB	Type SC
Minimum Length	3'	2'	1'
Maximum Length	6'	6'	6'
Thickness	5" to 8"	5" to 8"	3" to 6"
Width of face	12"	11" to 13"	11" to 13"

When the edging is used on curves of one hundred sixty (160) feet radius or less the length shall be as directed by the Engineer.

TYPE SA EDGING.—The exposed face shall be smooth quarry split to an approximately true plane having no projections or depressions which will cause over one (1) inch to show between a two (2) foot straight edge and the face when the straight edge is placed as closely as possible on any part of the face. If projections on the face are more than that specified they shall be dressed off. The top and bottom lines of the face shall be pitched off to a straight line and shall not show over one-half ($\frac{1}{2}$) an inch between stone and straight edge when straight edge is placed along the entire length of the top and bottom lines and when viewed from a direction at right angles to the plane of the face, and for the top line only not over one-half ($\frac{1}{2}$) an inch when viewed from a direction in the plane of the face. The ends shall be square to the length at the face and so cut that when placed end to end as closely as possible no space shall show in the joint at the face of over three-quarters ($\frac{3}{4}$) of an inch. The arris formed by the intersection of the plane of the face with the plane of the end joint shall not vary

from the plane of the face or the plane of the joint more than one-quarter ($\frac{1}{4}$) inch. Drill holes may show on the exposed face but only along the bottom edge. The sides shall not be broken under the square more than four (4) inches and the side adjacent to the grass shall not project over one (1) inch.

TYPE SB EDGING.—The exposed face shall be smooth quarry split to an approximately true plane having no projections or depressions which will cause over one (1) inch to show between a two (2) foot straight edge and the face when the straight edge is placed as closely as possible on any part of the face. If projections on the face are more than that specified they shall be dressed off. The top and bottom lines of the face shall be pitched off to a straight line and shall not show over one (1) inch between stone and straight edge when straight edge is placed along the entire length of top and bottom lines and when viewed from a direction at right angles to the plane of the face, and for the top line only not over one (1) inch when viewed from a direction in the plane of the face. The ends shall be square to the length at the face and so cut that when placed end to end as closely as possible, no space shall show in the joint at the face of over one and one-half ($1\frac{1}{2}$) inches. The arris formed by the intersection of the plane of the face with the plane of the end joint shall not vary from the plane of the face more than one-quarter ($\frac{1}{4}$) of an inch. Drill holes not more than three and one-half ($3\frac{1}{2}$) inches in length and one-half ($\frac{1}{2}$) inch in depth will be permitted. The sides shall not be broken under the square more than four (4) inches and the side adjacent to the grass shall not project over one (1) inch.

TYPE SC EDGING.—The exposed face shall be smooth quarry split to an approximately true plane having no projection or depressions which will cause over one-half ($\frac{1}{2}$) inch to show between a two (2) foot straight edge and the face when the straight edge is placed as closely as possible on any part of the face. If projections on the face are more than that specified they shall be dressed off. The top and bottom lines of the face shall be pitched off to a straight line and shall not show over one (1) inch between stone and straight edge when straight edge is placed along the entire length of top and bottom lines and when viewed from a direction at right angles to the plane of the face, and for the top line only not over one (1) inch when viewed from a direction in the plane of the face. The ends shall be square to the length at the face and so cut that when placed end to end as closely as possible no space shall show in the joint at the face of over one and one-half ($1\frac{1}{2}$) inches. The arris formed by the intersection of the plane of the face with the plane of the end joint shall not vary from the plane of the face more than one-quarter ($\frac{1}{4}$) of an inch. Drill holes not more than three and one-half ($3\frac{1}{2}$) inches in length and one-half ($\frac{1}{2}$) inch in depth will be permitted. The sides shall not be broken under the square more than four (4) inches and the side adjacent to the grass shall not project over one (1) inch.

CONSTRUCTION METHODS

SETTING. — The foundation is to be made of gravel, and consist of material as specified under Section A-3. The trenches for the granite edging are to be eighteen (18) inches wide and the subgrade is to be sixteen (16) inches below the top of the finished granite edging. Upon this subgrade a foundation is to be made of good, clean, coarse gravel, thoroughly rammed so it shall be four (4) inches thick and the full width of the trench when completed. Upon this foundation additional gravel of the same kind shall be placed as required and the granite edging set thereon. All spaces under the stones shall be filled with gravel as specified above and tamped so that the granite edging will bear and be completely supported throughout its entire length and width at the required line, grade and slope. All joints shall be made as close as possible, but stones shall not be set nearer to each other than one quarter ($\frac{1}{4}$) of an inch.

GRANITE EDGING JOINTS. — The joints between the granite edging shall be carefully filled with mortar composed of one (1) part Portland cement and two (2) parts clean sand.

MEASUREMENT AND PAYMENT

The quantity of granite edging to be paid for will be the length actually laid in accordance with the plans or as directed by the Engineer as measured along the front arris of the edging.

Granite edging will be paid for at the contract unit price per lineal foot furnished and installed in place, which price shall include full compensation for all materials used except gravel or crushed stone for the foundation, rock excavation and (when not removed by a mechanical shovel) roadway base and pavement.

PAYMENT ITEMS

B3-1 — Granite Edging Lineal Feet

B4-1 — GRANITE-FACED PRECAST CONCRETE CURB.

GENERAL

The concrete curb shall be made of Portland cement, fine aggregate, coarse aggregate and water, mixed in proportions to produce the required strength of curb herein specified. The curb shall have facing stones embedded in the wearing surface as herein specified.

MATERIALS

REQUIREMENTS. — The Portland cement, fine aggregate, coarse aggregate and water shall meet the requirements hereinafter specified for these materials. The facing stones shall consist of crushed granite having a percentage of wear not to exceed 4.5. The percentage of wear shall be determined in accordance with the Standard Method of Test for Abrasion of Rock (A.S.T.M. Designation: D2-23) of the American Society for Testing Materials, or revision thereof.

COARSE AGGREGATE. — Coarse aggregate shall consist of clean, hard, strong, durable crushed granite or trap rock. All coarse aggregate shall be free from injurious amounts of soft, friable, thin, elongated, or laminated pieces, alkali, loam, or other deleterious matter.

SAND. — Fine aggregate shall be sand having hard, strong, durable particles, free from soft or flaky particles, shale, loam, alkali, organic matter or other deleterious substances. Natural sands shall be washed. It shall contain not more than three per cent (3%) of silt by weight, as determined by decantation.

Sand, when subjected to the colorimetric test for organic impurities and producing a color darker than the Standard Figure 2 of the A.S.T.M., shall be rejected. Fine aggregate shall be well graded from coarse to fine and when tested by means of laboratory sieves shall conform to the following requirements:

									Per Cent by Weight
Passing No.	4 sieve	.	.	.	.	.	.	.	95 to 100
Passing No.	8 sieve	.	.	.	.	.	.	.	80 to 95
Passing No.	16 sieve	.	.	.	.	.	.	.	45 to 80
Passing No.	30 sieve	.	.	.	.	.	.	.	25 to 50
Passing No.	50 sieve	.	.	.	.	.	.	.	13 to 20
Passing No.	100 sieve	.	.	.	.	.	.	.	0 to 5

SIEVE ANALYSES. — The sieves themselves and the methods of making the sieve analyses shall conform to the requirements specified in the Standard Method of Test for Sieve Analyses of Aggregate for Concrete (A.S.T.M. Designation: C136-39) of the American Society for Testing Materials, or revision thereof.

ORGANIC IMPURITIES ANALYSES. — The Standard Method of Test for Organic Impurities in Sands for concrete (A.S.T.M. Designation: C40-33) of the American Society for Testing Materials, or revision thereof will be used to determine the presence of organic impurities in the sand. Samples will generally

be taken at the source of production for complete laboratory analysis, which will be made promptly, and no material shall be used except at the risk of the Contractor, until the results of such analysis are made known.

CEMENT. — Cement shall be an approved brand of true Portland cement conforming to the requirements of the Standard Specifications for Portland Cement (A.S.T.M. Designation: C150-41) of the American Society for Testing Materials, or revision thereof.

WATER. — Fresh and clean water, suitable for drinking purposes, shall be used exclusively for making and curing of concrete.

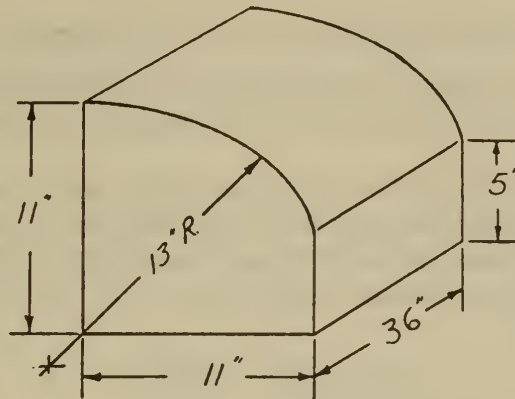
FACING STONES. — The facing stones shall be pieces of granite each piece having a surface area of about five (5) square inches and a depth of from two (2) to two and one half ($2\frac{1}{2}$) inches. The best face of each piece shall be in the plane of the wearing surface, and the pieces shall cover from sixty (60) to sixty-five (65) per cent of the area of the curb. The pieces shall be placed in the wearing surface of the curb in one plane, and form a protection for the edges and corners of the curb. The interstices between facing stones shall not be less than one (1) inch or more than one and one half ($1\frac{1}{2}$) inches and shall be filled with mortar consisting of one (1) part white cement to not more than one and one half ($1\frac{1}{2}$) parts of fine aggregate, consisting of white sand, mixed with water.

STRUCTURE AND SURFACE. — The curb shall be dense and free from imperfections. The wearing surface shall have an approved texture of exposed granite that will provide a uniform surface. The bottom and sides shall be smooth. The granite is to be of a dark cast so as to contrast with the white mortar joints.

CLASSIFICATION. — The curb shall be cast to the dimensions shown on sketch below.

Curbing having a radius 25 feet or longer shall be classified as "straight."

Curbing having a radius less than 25 feet shall be classified as "circular."



MANUFACTURE. — The curb shall be manufactured by an approved mechanical method of producing a positive vibrating action. Immediately after molding, the curb shall be carefully racked and stored in a steam curing chamber for a period of not less than sixteen (16) hours. Upon removal from the curing chamber, the curb shall be stored under conditions which shall protect it adequately from rapid drying. The date of manufacture shall be clearly marked on the side of each piece of curb.

STRENGTH. — The concrete curb shall have a crushing strength of not less than four thousand (4,000) pounds per square inch.

TESTING AND SAMPLES. — All materials, as well as the plant and method of manufacture, shall be subject at all times to the inspection and approval of the Engineer.

Samples of all materials for test, upon which is to be based the acceptance or rejection of the supply, shall be taken by the Engineer.

The Contractor shall furnish the Engineer with facilities for sampling the materials in use, or to be used, before the beginning and during the course of the work.

Whenever, during the course of the work, new deliveries of materials are received by the Contractor, their use will not be permitted until they have been examined and approved by the Engineer.

If required by the Engineer, the curb selected for physical tests shall be shipped at the Contractor's expense to the laboratory designated by the Engineer.

Curb having any of the following defects will be rejected.

- (a.) Curb varying in size more than the specified amount, or misshaped so that it will not form a proper surface or align correctly with other curbing.
- (b.) Curb that is cracked, chipped, spalled or broken.
- (c.) Curb that is coated with dirt, excess mortar, or foreign material.

No curb shall be shipped from the point of manufacture until the samples have successfully passed the tests and until all curb has been approved as to surface texture.

CONSTRUCTION METHODS

The subbase or foundation for the precast curb shall consist of crushed stone placed on the subgrade to a depth not less than six (6) inches.

Upon the prepared subbase shall be laid a dry mortar cushion of one (1) part cement and five (5) parts sand, which shall be spread and screeded to the proper grade. The cushion shall be one (1) inch in depth.

The curb shall be placed on this cushion as shown on plans, or as directed.

The curb shall be placed with a one quarter ($\frac{1}{4}$) inch joint pointed with cement mortar.

The curb shall be backfilled as directed by the Engineer and due care exercised not to disturb the curb alignment.

MEASUREMENT AND PAYMENT

The quantity of straight and circular granite faced curb to be paid for will be the length actually laid in accordance with the plans or as directed by the Engineer as measured along the front face of the curb.

Straight or Circular Granite Faced Precast Concrete Curb will be paid for at the respective contract unit prices under each Payment Item for such work, complete in place, each of which prices will include full compensation for the cement-sand bed and mortar joint pointing.

The cost of excavation, rock excavation, crushed stone and roadway base and pavement will be paid under their respective Items.

PAYMENT ITEMS

B4-1 — Straight Granite Faced Concrete Curb	. . . . .	Lineal Feet
B4-2 — Circular Granite Faced Concrete Curb	. . . . .	Lineal Feet
B4-3 — Granite Faced Concrete Curb Corners	. . . . .	Each

B 5-1 — GRANITE BLOCK HIP GUTTERS

The granite blocks are to be laid in concrete base Class B. The blocks are to be firmly imbedded in the concrete. All joints shall be broken with a lap of at least three (3) inches. The concrete foundation is to be four (4) inches wider than the three (3) rows of granite block and is to be four (4) inches in depth.

Immediately after being brought to a uniform surface, the block shall be wet and Portland cement grout shall be spread over the surface with brooms, hoes, squeegees, or other suitable tools; until the joints are entirely filled and the surface is covered to the depth of about one-half ($\frac{1}{2}$) inch with the grout.

The hip gutters are to be laid to required line and grade.

The granite block hip gutters are to be approximately twelve (12) inches in width and the slope will be determined by the water line. For detail of typical granite block hip gutter see plan on file in Public Works Department.

MEASUREMENT AND PAYMENT

The quantity of granite block hip gutter shall be the lineal feet of granite block hip gutter, measured in place, laid in accordance with the plans or as directed by the Engineer.

Granite block hip gutters will be paid for at the contract unit price per lineal foot of granite block hip gutter complete in place including concrete base, cement grout jointing and the hauling of any granite block needed (which will be furnished by the City) from the City Yard to the site of the work.

PAYMENT ITEM

B5-1 — Granite Block Hip Gutter.....Lineal Feet

SECTION C-1

PORTLAND CEMENT CONCRETE

C1-1 — PORTLAND CEMENT CONCRETE BASE

GENERAL

Cement concrete for roadways, sidewalks and driveways shall be constructed to the dimensions and design indicated on the plans and to the lines and grades established by the Commissioner.

Where necessary, at the direction of the Commissioner, the dimensions or design may be adjusted to fit foundation, slope or construction conditions as encountered.

MATERIALS

CONCRETE.—Portland Cement Concrete Base shall be Class C, conforming to these specifications, mixed and proportioned in accordance with the tables set forth hereinafter, and as designated on the plans and/or as called for in the Special Provisions.

CEMENT.—Unless otherwise specified in the Special Provisions for a particular project, all cement shall be American Portland cement of a brand satisfactory to the Commissioner, and conforming to the "Standard Specifications for Portland Cement", A.S.T.M. Designation: C-150, and only one type of cement shall be used in a single structure. When an air-entrained concrete is specified to be used, the methods and materials to produce such concrete shall conform to the applicable requirements hereinafter specified.

STANDARD PORTLAND CEMENT.—All cement used shall be Portland cement of American manufacture, shall be tested by the Department's Material Testing Laboratory and shall comply with the requirements of the latest standard specifications of the American Society for Testing Materials for Portland cement. (Serial Designation C150, Type I, or revision thereof.)

AIR-ENTRAINING PORTLAND CEMENT.—All cement used under this designation shall conform to standard specifications of the American Society for Testing Materials for Air-Entraining Portland Cement, Serial Designation C-175 or latest revision thereof.

AIR-ENTRAINED CEMENT CONCRETE.—When an air-entrained concrete is specified to be used in any of the Items of the contract the proportions of aggregate given in the table set forth hereinafter shall be reduced to compensate for the air content of the concrete in order to maintain the specified minimum cement factor. A reduction of approximately forty (40) pounds of aggregate per cubic yard of concrete is required for each per cent of entrained air to be obtained in the concrete in order to maintain the specified cement factor. Air-entrained concrete generally permits a small reduction in the water content of the mix and a small reduction in the sand-total aggregate ratio.

The air-content of the concrete shall be not less than four (4) per cent nor more than six (6) per cent by volume when tested in accordance with Standard Method C138 of the A.S.T.M. for weight per cubic foot, yield, and air content (Gravimetric) of concrete, or by other approved methods.

In all air-entrained concrete the specified amount of entrained air shall be obtained by one of the following methods which may be adapted to the requirements of construction:

A. NORMAL PORTLAND CEMENT AND ADMIXTURES.—This method comprises the use of a normal Portland cement of the type required with an approved admixture introduced at the mixer. The amount of air-entraining agent added shall be accurately proportioned and added in the required amount by an approved measuring device. A list of approved air-entraining agents may be secured from the Department.

B. AIR-ENTRAINING PORTLAND CEMENT.—This method comprises the use of an air-entraining Portland cement of the type specified.

If the air content of the concrete at any time during the construction is not sufficient, the Contractor shall add as much additional air-entraining agent at the mixer as the Engineer may from time to time require. The agent added at the mixer shall be listed as approved by the Department.

C. **BLENDED NORMAL PORTLAND CEMENT AND NATURAL CEMENT.**—When concrete is produced by using a blend of normal Portland cement (Type II) and an approved natural cement, the normal Portland cement shall be blended on the job with the natural cement. The amount of natural cement used shall be as approved by the Engineer, but the blend shall be so proportioned as not to exceed one (1) part of natural cement to seven (7) parts normal Portland cement by weight.

SCOPE OF CONTROL FOR PROPORTIONING.—The responsibility of the Department is confined to the inspection of the following four factors controlling the mix:

A. **MINIMUM CEMENT CONTENT AND MINIMUM STRENGTH.**—The cement proportion is subject to adjustment and approval by the Commissioner in order to insure compliance with minimum strength requirements. Standard field test specimens (A.A.S.H.O. T23) shall be taken on the job and the Contractor shall be required to add additional cement as directed by the Commissioner if test specimens fail to meet the minimum strength requirements.

No claims shall be allowed for extra cement or extra concrete due to variations in materials, proportioning, dimensions, shrinkage, waste and similar causes. The Contractor is advised to anticipate a normal loss in yield of 1 or 2 per cent due to the foregoing causes.

B. **CONSISTENCY.**—The Contractor shall uniformly regulate the consistency of the mix to the slump test as directed by the Engineer. The Engineer shall reject all batches not conforming to this requirement and the Contractor shall receive no compensation therefor.

The following general requirements in regard to consistency are given for the Contractor's information; for mass concrete 2- to 3-inch slump, for reinforced concrete 3- to 5-inch slump according to placing conditions, for very constricted placing conditions 5- to 6-inch slump. The Engineer will specify the lowest slump with which it is practicable to properly place and consolidate the mix within the forms.

C. **WORKABILITY.**—The Engineer may vary the proportion of fine aggregate in order to regulate the workability or density of the mix, making an equivalent change in the coarse aggregate to keep the yield constant.

D. **AIR CONTENT.**—If entrained air is required in the concrete the amount obtained shall be uniformly regulated to conform to the limiting percentages specified. If for any reason the specified air-entrainment cannot be obtained the Contractor shall, as directed, adjust the proportioning of the mix or make such changes in the method of mixing as may be necessary in order to insure full compliance with the specific requirements for air-content of the concrete. When a blend of natural cement and normal Portland cement is in use, the proportion of natural cement shall not exceed that herein specified.

HIGH EARLY STRENGTH PORTLAND CEMENT.—All cement used under this designation shall be High Early Strength Portland Cement of American manufacture, shall be tested by the Department's Material Testing Laboratory and shall comply with the requirements of the latest standard specifications of the American Society for Testing Materials for High Early Strength Portland Cement. (Serial Designation C-150, Type III, or revision thereof.)

WATER.—Water for concrete and mortar shall be subject to the approval of the Commissioner and shall be free from injurious amounts of oil, acid, alkali, organic matter or other deleterious substances. It shall be equal to potable water in physical and chemical properties.

FINE AGGREGATE.—The fine aggregate shall consist of sand composed of grains or particles of quartz or other hard and durable rocks, the surfaces of which are not coated with any foreign material nor worn smooth. The grains shall be moderately sharp, free from soft, decomposed or partly decomposed sand grains, lumps of clay or ferruginous cemented sand, mica, loam, sea salts, organic matter or other foreign materials and, when subjected to the A. S. T. M. color test for organic impurities and

producing a color in sodium hydroxide solution darker than Figure 2, shall be rejected. If the fine aggregate is washed, it shall be allowed to stand at least twenty-four (24) hours in piles after washing before being used, if so directed. Fine aggregate shall conform to American Society for Testing Materials. Specifications C33.

The sand shall be well graded from coarse to fine and, when tested by means of laboratory screens and sieves, shall meet the following requirements:

Passing No. 4 sieve	95%-100%
Passing 16-mesh sieve	45%- 80%
Passing 50-mesh sieve	10%- 30%
Passing 100-mesh sieve	2%- 10%

COARSE AGGREGATE.— Coarse aggregate shall consist of broken stone or screened gravel, uniformly graded between the limits specified in the following table. Coarse aggregate shall be separated into two sizes and recombined in approximately equal proportions by weight. Separated coarse aggregate shall be weighed and batched separately for each batch of concrete.

Broken stone shall consist of clean, hard, tough, durable rock, free from soft, thin, elongated or laminated pieces, disintegrated stone, vegetable or other deleterious matter, and shall have a percentage of wear not more than 5 (French coefficient of wear not less than 8).

Screened gravel stone shall consist of clean, hard, durable rock, free from soft, thin, elongated or laminated pieces, disintegrated stone, vegetable or other deleterious matter and shall be thoroughly washed.

PER CENT BY WEIGHT PASSING STANDARD SQUARE MESH SIEVE

SIEVE SIZE	Aggregate Designated 2 Inch to No. 4	Aggregate Designated 1½ Inch to No. 4
2½ Inch	100	—
2 Inch	95-100	100
1½ Inch	—	95-100
1 Inch	35-70	—
¾ Inch	—	35-70
½ Inch	10-30	—
⅜ Inch	—	10-30
No. 4	0-5	0-5

All materials must meet the approval of the Commissioner. Written approval must be obtained before fine or coarse aggregate from more than one source of supply will be allowed. Coarse aggregates shall conform to American Society for Testing Materials, Specifications C33.

The limits shown in aggregate tables define master ranges of variation for general application and are minimum and maximum in each case. To insure uniformity of material the range of variation may be reduced by the Commissioner upon determination of the character and source of material that the Contractor proposes to furnish.

Stone retained in the largest sieve shall be within an oversize tolerance of ¼ inch.

Not more than 1 per cent of stone in any grading shall pass a No. 100 mesh sieve.

WATER.— Water used in mixing concrete shall be clean, and free from injurious amounts of oils, acids, alkalis, organic materials, or other deleterious substances.

CONCRETE PROPORTIONS AND CONSISTENCY.— The proportions of aggregate to cement for any concrete shall be such as to produce a mixture which will work readily into the corners and angles of the forms and around reinforcement with the method of placing employed on the work, but without permitting the materials to segregate or excess free water to collect on the surface. The combined aggregates shall be of such composition of sizes that, when separated on the No. 4 standard sieve, the weight passing the sieve (fine aggregate) shall not be less than thirty per cent nor greater than fifty per cent of the total.

The methods of measuring concrete materials shall be such that the proportions can be accurately controlled and easily checked at any time during the work. Wherever practicable such measurement shall be by weight rather than by volume, and the proportions shall be approximately those listed in the following table, contingent upon the specific gravity of the aggregate. Measurement of materials for ready-mixed concrete shall conform to the "Standard Specifications for Ready-Mixed Concrete" (A. S. T. M. Designation: C94).

STORAGE.—Cement and aggregates shall be stored off the ground in a dry, ventilated structure in such a manner as to prevent deterioration or intrusion of foreign matter. Any material which has deteriorated or which has been damaged shall not be used for concrete.

TESTING CEMENT.—Every facility shall be provided the Commissioner for careful sampling and inspection of the cement either at the mill or, if required, at the site of the work.

Cement testing shall be in accordance with the methods prescribed in the A. S. T. M. specifications for the type of cement to be used and certified copies of all mill tests shall be furnished in triplicate, if required. The Commissioner may also have independent tests made of the cement to be furnished from samples taken at the mill, mixing plant, or at the site of the work. All samples of cement required for testing shall be furnished to the Commissioner at designated places.

CLASSIFICATION OF CONCRETE

CLASS	Minimum Cement Content Lbs./C.Y.	COMPRESSIVE STRENGTH		Coarse Aggregate Max. Size Inches	Water Approx. Gallons	Sand Lbs.	Gravel Stone Lbs.	Sand Lbs.	Crushed Stone Lbs.
		7 Days	28 Days						
A	560	1,800	3,000	1½	34-37	1,230	2,010	1,360	1,880
B	500	1,500	2,500	1½	34-37	1,210	2,060	1,340	1,930
C	440	1,200	2,000	1½	34-37	1,190	2,110	1,310	1,990
D	620	1,800	3,000	¾	37-40	1,330	1,770	1,470	1,630
E	720	1,800	3,000	¾	42-45	1,330	1,500	1,470	1,360
F	610	2,100	3,500	1½	32-34	1,190	2,030	1,310	1,910

NOTES. —

Specific gravity of average aggregates = 2.65

Quantities give are for surface dry aggregates

Air-entrainment, when called for, = 4%

Slump for pavement concrete shall be 1½"-2½" for regular, and 2"-3" for air-entrained.

1-1 Mix Mortar

Cement 1,532 lbs. — sand 1,790 lbs.

1-2½ mix with emulsified carbon black

Cement 893 lbs. — sand 2,740 lbs. — Emulsified carbon black 3½ lbs.

The classification table and all other pertinent information set forth on this page shall govern all references made thereto throughout the Standard Specifications covering all Divisions of the Public Works Department, the Special Provisions, Amendments, and any Addenda that may be issued.

BATCH MIXING. — The batch mixer shall be of a standard rotating drum type, in good mechanical condition and approved by the Commissioner. It shall have the capacity required by the Commissioner but in no case shall a mixer of less than three-quarters ($\frac{3}{4}$) cubic yard capacity be used. The Contractor shall not be allowed to mix batches greater than the manufacturer's rated capacity of the mixer.

The entire contents shall be removed from the drum before materials are placed therein for the succeeding batch. The concrete shall be thoroughly mixed for the following minimum period after all materials are in the drum:

Batch one cubic yard or less — mixing time one minute.

Batch over one cubic yard — mixing time one minute plus 15 seconds for each cubic yard additional, or fraction thereof.

During the mixing the mixer drum shall revolve at a speed not to exceed the manufacturer's rating.

READY-MIXED CONCRETE. — Ready-mixed concrete shall conform to the requirements of the Standard Specifications for Ready-Mixed Concrete A.S.T.M. C94 or current revisions thereof except where said specifications conflict with the specific provisions of this contract specification.

TRUCK MIXER. — The truck used for transporting central plant mixed concrete shall be of a standard rotating drum type approved by the Commissioner.

The concrete shall be thoroughly mixed for a period of not less than four minutes after all the materials are in the drum and, during the mixing, the mixing drum shall revolve at an approved mixing speed. Concrete shall not remain in any truck over one hour after the cement has been added to the aggregate.

Any concrete delivered that does not conform with the slump requirement shall be rejected by the Inspector on the work.

No admixture, acceleration agent, stone dust or stone sand, may be added to the concrete without permission of the Commissioner.

Concrete shall not be mixed or placed when the air temperature is lower than 35 degrees Fahrenheit on a rising temperature and 40 degrees Fahrenheit on a falling temperature.

When calcium chloride is added to the mixture the quantity used shall be not more than two per cent (2%) of the quantity of the cement by weight. The calcium chloride solution shall be considered as part of the mixing water and shall be discharged into the mixer accompanying or following the required charge of water.

The mixer shall be equipped with a positive and approved method of introducing the calcium chloride in solution form into the drum for each batch of concrete.

Prior to concreting operations the Contractor shall furnish a statement to the Commissioner, giving the proportions by weight (dry) of the cement, fine and coarse aggregates, which will be used in the manufacture of each class of concrete called for and shall furnish evidence to the Commissioner that the proportions selected will produce concrete that will meet the contract specifications for strength and plasticity. No change in the proportions accepted shall be made without the Commissioner's knowledge and consent. The Commissioner may, at his discretion, vary the proportion of fine aggregate in order to regulate the workability or density of the mix, making an equivalent change in the coarse aggregate to keep the yield constant, but in no case will a change be allowed in the specified water cement ratio or minimum cement content.

PLANT INSPECTION. — At the discretion of the Commissioner a representative of the Public Works Department shall be stationed at each plant delivering concrete, to check the weight of materials so that they may conform with the specifications of concrete being delivered, to observe the aggregate and regulate deliveries and make out load slips, and to report any infraction of requirements. At the discretion of the Commissioner any and all materials used will be tested by American Society for Testing Materials designation or Bureau of Standards or American Association of State Highway Officials.

PREMOLDED JOINT FILLER. — All expansion joints shall be constructed using premolded non-extruding filler of cork, sponge rubber, cork-rubber compound or other materials approved by the Commissioner meeting the requirements of Standard Specifications for Preformed Expansion Joint Filler for Concrete, A.S.T.M. Designation D-544, and subject to test designated for same.

JOINT SEAL. — The seal for the top portion of the joints shall consist of an asphalt mastic compound as specified hereinafter.

(a.) OIL ASPHALT MASTIC. JF-MA. — This filler shall consist of a uniform blend of from seventy-five (75) to eighty-five (85) per cent by weight of oil asphalt and from fifteen (15) to twenty-five (25) per cent by weight of mineral filler.

The oil asphalt shall conform to the requirements of specification M-20-26 of the A.A.S.H.O. for sixty to seventy penetration.

The mineral filler shall pass a No. 200 sieve and be of such character and fineness that, when uniformly blended with the asphalt cement, no appreciable separation will occur while being maintained in a liquid condition.

(b.) NATURAL ASPHALT MASTIC. JF-NA. — This filler shall consist of an asphaltic cement containing from twenty (20) to thirty (30) per cent of the fine material matter naturally occurring therein, and which, without the addition of any other material, shall meet the following requirements:

The asphalt cement filler shall be homogeneous, free from water and shall not foam when heated to 175 degrees Centigrade (347 degrees Fahrenheit).

It shall have:

- | | |
|--|--------------------------------------|
| 1. Specific gravity 25°/25° C. (77°/77° F.) | 1.22 to 1.30 |
| 2. Flash point, open cup | Min. 175° C. (347° F.) |
| 3. Melting point | 48° C. (118° F.) to 57° C. (135° F.) |
| 4. Penetration at 25° C. (77° F.) 100 gms. 5 sec. | 40 to 50 |
| 5. Loss 50 gms. 160° C. (325° F.) 5 hours | Max. 3% |
| a. Penetration of residue at 25° C. (77° F.) 100 gms. 5 sec. | Min. 20% |
| 6. Total bitumen (soluble in carbon disulphide) | 65 to 75% |
| a. Inorganic matter soluble | 20 to 35% |
| 7. Ductility at 77° F. | Min. 30 cm. |

CONSTRUCTION METHODS

GENERAL. — Upon the properly prepared subgrade shall be laid a concrete base, which, after spreading, shall be as thick as specified in the Special Provisions.

Concrete for roadway base shall be allowed to set for a period of five (5) days, and the asphalt binder and top shall be applied immediately thereafter.

FORMS. — Approved centers and forms conforming to the design of the work shall be provided by the Contractor. They shall be in good condition and cleaned and oiled or properly treated as required. Forms shall be jointed tightly to prevent leakage from the mix and shall be of sufficient strength to hold the concrete without bulging between supports.

HANDLING AND PLACING CONCRETE.

A. TRANSPORTATION. — The concrete shall be transported from the mixer and placed in the forms by a method which will permit handling concrete of the slump required without segregation. Buggies and wheelbarrows used for this purpose shall be equipped with pneumatic tires. Chutes shall be metal or metal lined, sloped to a pitch of between 1 to 2 and 1 to 3. Long chutes shall be provided with reversed flow or remixing hoppers in order to correct for segregation.

B. DEPOSIT. — The concrete shall be placed in the forms in an approved manner to prevent stone pockets, voids or segregation and to reduce rehandling and flowing in the forms to a minimum. The concrete shall not be dropped more than three (3) feet or flowed or dragged over ten (10) feet in the forms. Points of deposit shall be spaced not more than twenty (20) feet apart nor more than ten (10) feet from the ends of the form. Concrete shall be properly distributed in the forms by shoveling. The forms shall be filled in thin horizontal layers, each layer extending completely across the forms.

C. JOINTS. — The Contractor shall construct weakened plane transverse contraction joints in the concrete base course every fifty feet or as shown on plan or as directed. These joints shall be made

by forming a suitable groove in the upper portion of the slab transversely for the full width of the base course in a straight line and extending vertically downward from the finished surface for a depth of three-quarters ($\frac{3}{4}$) of an inch. Care shall be taken in forming the groove not to disturb the concrete unduly.

Pre-molded asphalt filler shall be placed along the face of edgestone before concrete base is poured to allow for expansion.

PROTECTION, CURING AND FINISHING

A. PROTECTION. — Precautions shall be taken to thoroughly protect the concrete from damage by rain, sun, and cold weather during and after laying.

Concrete shall not be poured in cold and freezing weather except under full responsibility by the Contractor and only under the conditions outlined. Any concrete damaged by exposure shall be removed and replaced by the Contractor at his own expense.

During cold weather the concrete shall be fully protected until properly set and hardened to prevent damage. The concrete shall be placed and maintained at a minimum temperature of 50 degrees for the entire curing period.

In case of extreme weather, the Commissioner may, at his discretion, raise the lower limiting temperature for water, aggregate, and mixed concrete.

During warm and dry weather, and as directed, all new concrete shall be kept well shaded from the sun and well sprinkled with water until set.

B. CURING. — The concrete shall be kept fully saturated and protected against any drying action by an approved method of curing.

MEASUREMENT AND PAYMENT

The cement concrete base will be measured by the cubic yard complete in place.

The cement concrete base will be paid for at the contract unit price per cubic yard. The price paid per cubic yard shall include full compensation for the furnishing and laying of the premolded asphalt filler, the furnishing of all aggregate and cement, for mixing, placing, screeding, finishing, curing, and protecting the concrete, for forming joints of all kinds, and will be paid on the basis of the actual volume of concrete furnished and placed by the Contractor and certified to by the Department representative at the concrete plant, subject to the following restrictions.

NOTE:—The Contractor will be paid for all concrete base furnished up to a maximum of six (6) per cent in excess of the specified depth computed separately for each street in the Contract.

The City will not pay for any concrete base furnished in excess of the specified depth plus the above referenced tolerance of six (6) per cent.

PAYMENT ITEM

C1-1 — Portland Cement Concrete Base — Class B.....Cubic Yards

C1-2 — CONCRETE WALL FOR BACKING UP SIDEWALKS.

GENERAL

Concrete for backing up sidewalks shall be Class B Concrete used in a wall ten (10) inches wide and up to five (5) feet high overall where directed by the Engineer. The wall shall be not more than two and one-half ($2\frac{1}{2}$) feet below ground on the exposed side. Forms shall be used on both sides from bottom of wall to four (4) inches below finished grade for artificial stone sidewalks, and for all other sidewalks, forms shall be used on both sides from bottom of wall to the finished grade of the back of sidewalk. Forms shall be made of planed lumber or plywood on the exposed side of the wall. All forms shall be thoroughly braced to prevent warping and to assure a true line. Expansion joints shall be provided at least every fifty (50) feet and shall consist of three quarter ($\frac{3}{4}$) inch premolded asphalt filler for the full depth of the wall.

MEASUREMENT AND PAYMENT

Payment for backing up sidewalks will be made at the contract unit price per cubic yard measured complete in place, which price shall include full compensation for all labor, materials, tools and equipment, excavation and backfill, construction and removal of forms; expansion joints and joint filler; surface finish; and all other items of expense required to complete the work in accordance with the plans, applicable requirements, and/or the Special Provisions, if any.

PAYMENT ITEM

C1-2 — Concrete Wall for Backing Up Sidewalks.....Cubic Yards

C 1-3— CEMENT CONCRETE PAVEMENT

GENERAL

Cement concrete pavement shall consist of Portland cement concrete constructed upon the properly prepared subgrade with class A concrete, and as shown on plan on file in the Public Works Department.

MATERIALS

Concrete shall conform to the requirements hereinbefore specified.

PREMOLDED JOINT FILLER.—All expansion joints shall be constructed using premolded non-extruding filler of cork, sponge rubber, cork-rubber compound or other materials approved by the Commissioner meeting the requirements of Standard Specifications for Preformed Expansion Joint Filler for Concrete, A.S.T.M. Designation D-544, and subject to test designated for same.

JOINT SEAL.—The seal for the top portion of the joints shall consist of an asphalt mastic compound as specified hereinafter.

(a.) **OIL ASPHALT MASTIC. JF-MA.**—This filler shall consist of a uniform blend of from seventy-five (75) to eighty-five (85) per cent by weight of oil asphalt and from fifteen (15) to twenty-five (25) per cent by weight of mineral filler.

The oil asphalt shall conform to the requirements of specification M-20-26 of the A.A.S.H.O. for sixty to seventy penetration.

The mineral filler shall pass a No. 200 sieve and be of such character and fineness that, when uniformly blended with the asphalt cement, no appreciable separation will occur while being maintained in a liquid condition.

(b.) **NATURAL ASPHALT MASTIC. JF-NA.**—This filler shall consist of an asphaltic cement containing from twenty (20) to thirty (30) per cent of the fine material matter naturally occurring therein, and which, without the addition of any other material, shall meet the following requirements:

The asphalt cement filler shall be homogeneous, free from water and shall not foam when heated to 175 degrees Centigrade (347 degrees Fahrenheit).

It shall have:

1. Specific gravity 25°/25° C. (77°/77° F.)... 1.22 to 1.30
2. Flash point, open cup..... Min. 175° C. (347° F.)
3. Melting point..... 48° C. (118° F.) to 57° C. (135° F.)
4. Penetration at 25° C. (77° F.) 100 gms. 5 sec..... 40 to 50
5. Loss 50 gms. 160° C. (325° F.) 5 hours..... Max. 3%
 - a. Penetration of residue at 25° C. (77° F.) 100 gms. 5 sec..... Min. 20%
6. Total bitumen (soluble in carbon disulphide)..... 65 to 75%
 - a. Inorganic matter soluble..... 20 to 35%
7. Ductility at 77° F..... Min. 30 cm.

CONSTRUCTION METHODS

FORMS.—The forms shall be of an approved metal type, of a width equal to the depth of the concrete, true to line, free from warp and of sufficient strength, when staked, to resist the pressure of the concrete without springing, and so designed that the various sections may be fastened together in such a manner as to prevent vertical or horizontal movement of the ends. Wooden forms, satisfactory to the Commissioner, may be used where the metal forms cannot be obtained.

The forms shall be joined neatly and tightly, shall be set true to line and grade, well staked and braced, and shall have uniform bearing on the foundation throughout their entire length.

In general, the setting of forms shall proceed at least two hundred (200) feet in advance of the mixing and placing of concrete. The forms shall be thoroughly cleaned and painted with oil before any concrete is placed against them and shall be made tight to prevent the leaking of mortar from the concrete.

FINE GRADING.—The fine grading of the foundation shall be done immediately after the operation of placing forms and the correctness of the cross section shall be determined by means of a template furnished by the Contractor. This template shall be either of wood or metal of such strength as to retain its shape when in use and light enough to be readily handled. The bottom surface, or scratch points, shall conform to the desired form of foundation. The foundation shall be tested at frequent intervals by drawing the template along the forms immediately ahead of the placing of the concrete, and all irregularities in the foundation shall be removed prior to the placing of any concrete thereon. If the foundation is loose and cannot be properly rolled and made firm, it shall be sprinkled and re-rolled just ahead of the laying of the forms and the placing of the concrete, so that the area between the forms is always smooth, firm and moist and free from ruts. The foundation shall be sprinkled again, and just before the concrete is placed, with as much water as will be readily absorbed.

PLACING CONCRETE.—Concrete shall not be mixed or placed when the temperature is lower than 35 degrees Fahrenheit on a rising temperature and 40 degrees Fahrenheit on a falling temperature.

When the temperature is below 50 degrees Fahrenheit, calcium chloride may be added to the mixture when directed. The quantity of calcium chloride used shall be not more than two (2) per cent of the quantity of the cement by weight. The calcium chloride solution shall be considered as part of the mixing water and shall be discharged into the mixer accompanying or following the required charge of mixing water. The mixer shall be equipped with a positive and approved method of introducing the calcium chloride into the drum for each batch of concrete.

Concrete shall be placed only when the temperature of the mixture is 50 degrees Fahrenheit or over, except when calcium chloride is allowed to be used as specified in the preceding paragraph.

Concrete shall be placed on a firm, smooth and moist foundation.

During dry weather, when traffic on the foundation would deposit wind-blown dust and dirt on freshly laid concrete before it can be covered with burlap, the Contractor shall sprinkle with water or otherwise treat the foundation to keep down the dust.

In no case shall concrete be deposited on a frozen foundation. If the mixer is operated on the foundation, planks shall be provided for the mixer to run on, so that the foundation shall be kept in good condition. The concrete shall be deposited on the foundation between the side forms, rapidly in successive batches, by means of a discharging device which does not cause separation of the mortar and the coarse aggregate. The concrete shall then be distributed to the required depth and for the entire width of the surfacing by shoveling or other approved methods. Rakes shall not be used for handling concrete. This operation shall be continuous and sections between expansion or contraction joints shall be completed without the use of intermediate forms or bulkheads. The concrete shall be carefully compacted by spading or vibrators inserted in the concrete along all side forms, longitudinal and transverse joints.

(a.) JOINTS.— Joints shall be formed as shown on attached plan or as directed.

(b.) JOINTS AT STRUCTURES.— Expansion joints shall be formed about all structures and features which project through, into or against the concrete pavement. Unless otherwise indicated, such joints shall be one-half ($\frac{1}{2}$) of an inch in width and shall be filled with premolded filler and sealed with joint filler compound as specified.

(c.) SEALING JOINTS.—After the curing period has expired and before the pavement is opened to traffic all joints shall be thoroughly cleaned of dirt, dust and any foreign matter and sealed with material as specified hereinbefore.

FINISHING.—The surface of the concrete shall be struck off by means of a steel template of approved section weighing not less than 15 pounds per linear foot width of pavement being constructed. The template shall be rolled to the desired cross section and shall have sufficient strength to retain its shape under all working conditions. The template shall be moved with a longitudinal and crosswise motion, moving always in the direction in which the work is progressing. Care shall be taken in moving the template forward that it is not lifted from the side forms, but is held securely against the top of the forms and moved forward uniformly, thus preventing undulations in the surface. The concrete shall be brought to a true and even surface, free from rock pockets, with the fewest possible number of passages of the finishing equipment.

After excess water has come to the surface the pavement shall be scraped with a straightedge from six (6) to ten (10) feet long, operated so that all excess water and laitance is drawn from the surface of the pavement.

BURLAP DRAG.— Following the scraping straightedges, the final surface texture shall be developed by use of a wet burlap strip dragged longitudinally over the pavement. The burlap shall be three to four feet wide without seams and the leading edge fastened to a wood pole for purpose of keeping burlap in proper position. Generally, two such drags should be used so that the complete operation may be in a forward direction without backing up.

The drags shall be cleaned of mortar when necessary so as to maintain uniform and satisfactory surface texture.

The surface of the concrete, after burlap drag operation, shall be uniform in appearance, shall have the required grade and contour, shall be free from surplus water, rough and porous spots, irregularities, depressions and other objectional surface features resulting from the improper handling of the tools. The entire operation shall be executed to the satisfaction of the Engineer.

SURFACE TEXTURE.— Final surface texture finish shall be obtained by lightly dragging an approved street or stable type broom across the surface of the pavement. Mortar and laitance accumulating on the broom shall be removed after each stroke of brooming.

FINISHING AT JOINTS.—The edges of the slabs on both sides of the transverse joint shall be finished to the same grade. The top transverse edges and the top lateral edges of the slab shall then be rounded to a radius of $\frac{1}{8}$ of an inch by means of approved edging tools. The transverse edges shall be rounded with an edging tool having a vertical leg of sufficient length to contact the vertical side of the preformed filler. The lateral edge adjacent to pavement already in place shall be rounded with an edging tool having a vertical leg $\frac{1}{4}$ inch wide and slightly longer than that used on the first slab.

The finishing of the concrete at joints shall be done from a bridge which shall not rest on the concrete at any point. The finishers shall use a short straightedge about $2\frac{1}{2}$ feet in length when finishing transverse joints to insure that both slab ends will be at the same elevation or grade.

FINISHING SCHEDULE.—The Contractor shall place only as much concrete pavement during any one day as may be properly finished during natural light of the same day, unless an adequate and approved artificial lighting system is provided and satisfactorily operated by him.

A sufficient number of competent concrete finishers shall be employed at all times to finish the concrete at the proper time and in the proper manner.

TESTING SURFACE.—After dragging the surface of the pavement shall be tested with a 10-foot straightedge attached to a handle of sufficient length to permit testing of the full width of the slab. The straightedge shall be laid parallel to the center line of the pavement and any irregularity of $\frac{1}{8}$ of an inch or greater shall be corrected immediately.

The surface of the concrete, after burlap drag operation, shall be uniform in appearance, shall have the required grade and contour, shall be free from surplus water, rough and porous spots, irregularities, depressions and other objectional surface features resulting from the improper handling of tools. The entire operation shall be executed to the satisfaction of the Engineer.

REMOVAL OF FORMS.—Forms shall not be removed for 24 hours after the concrete has been placed, or for a longer period if directed by the Engineer. Extreme care shall be taken in removing forms in order that no damage will be done to the concrete. Under no condition shall any bar, pick, or other tool be used which depends upon leverage on the concrete, for removal of the pins or forms.

As soon as side forms are removed and prior to sealing joints, the ends of all joints shall be opened and all mortar or foreign material shall be removed from the joint opening above the filler or other space as provided so that there will be complete freedom for the required movement.

After the forms have been removed all holes or honeycomb shall be promptly patched with mortar, of the same composition as that used in the pavement, which has been allowed to set for about $\frac{1}{2}$ hour after mixing.

PROTECTING AND CURING.—As soon as the finishing operations have been completed, the freshly laid concrete shall at once be protected by a covering of damp burlap or other approved material and cured in accordance with the following methods:

(a.) **PROTECTION OR INITIAL CURING.**—Burlap used for the protection or initial curing shall not be lighter than ten (10) ounces per square yard in weight and shall not have been previously used as a container for sugar. It shall be in good condition, free from holes, tears and other defects that will render it unsuitable for the purpose for which it is to be used. Burlap shall be furnished in strips not less than three (3) nor more than six (6) feet in width, and two and one-half ($2\frac{1}{2}$) feet longer than the width of the pavement slab, or in such other lengths as may be approved. The strips shall be laid on the fresh concrete surface carefully so as to avoid marring, and they shall overlap not less than three (3) inches. This burlap covering shall be kept thoroughly wet until it is removed. The initial curing shall be for a period of not less than twelve (12) hours.

(b.) **FINAL CURING.**—After initial curing as above and not later than ten (10) o'clock A.M. of the day following the placing of the concrete, the final curing of the concrete shall be commenced, using one of the following approved methods:

1. *Wetted Earth, Straw or Hay.*—The wet burlap shall be removed, the surface of the pavement thoroughly wetted and the entire exposed surface shall be covered on both top and sides with earth, straw or hay. Earth covering shall be not less than two (2) inches and straw or hay not less than six (6) inches deep after wetting. The covering shall be kept wet by sprinkling with the water as directed and shall remain for a period of not less than five (5) days unless otherwise directed.

2. *Wetted Burlap or Cotton Mat.*—When this method is to be used for the complete curing operations, the burlap used in the initial curing shall remain in place and the final curing shall proceed by covering the pavement with an additional layer of burlap conforming to the requirements for the first layer. The double layer of the burlap shall remain in place and shall be kept thoroughly saturated with water for a period of not less than five (5) days unless otherwise directed.

In lieu of the covering of burlap the concrete may be covered with cotton mats or other fabrics or mats, or membrane curing agents, approved by the Commissioner. Such coverings shall be as effective in preventing the evaporation of mixing water and controlling variations in the temperature of the concrete as two (2) thicknesses of wet burlap.

(c.) **WATER SUPPLY.**—The curing of concrete pavement shall be thorough and continuous throughout the entire curing period and, should the water supply at any time be inadequate for the requirements of both curing and mixing, curing shall take precedence and shall have priority rights to the water supply.

For each two thousand (2,000) square yards of concrete surfacing that has been laid less than five (5) days the Contractor shall assign at least one man who shall devote his entire time to watering the concrete surfacing.

(d.) **AIR CURING.**—After the period of the final curing has elapsed, the covering on the concrete shall be removed and the surface of the pavement swept clean. The concrete shall then be cured for an additional period of not less than one (1) day, or as much longer as necessary to allow the concrete to attain the strength required before being opened for travel as hereinafter specified.

(e.) **SPECIAL PRECAUTIONS.**—Additional protection for the pavement shall be provided, as directed, without additional compensation.

1. *Canvas Cover.*—Newly laid pavement shall be protected from damage by sun, rain, or cold weather, by covering it with a canvas cover supported above the surface of the pavement by wooden frames in such a manner that neither the canvas nor the frames will rest upon the surface of the concrete. Sufficient canvas to protect two hundred (200) lineal feet of pavement shall be provided and available for use at all times.

2. *Cold Weather Curing.*—During cold weather, the aforesaid canvas cover shall remain in place until the concrete has dried out and hardened sufficiently to proceed with the final stage of cold weather curing. This shall consist of covering the surface of the pavement to a depth of not less than six (6) inches with dry, loose straw or other approved material, which shall remain in place for not less than three (3) days.

3. *Protection from Traffic.*—The Contractor shall take suitable precautions to exclude foot traffic from the newly constructed pavement for a period of not less than three (3) days and he shall erect and maintain suitable barricades to exclude vehicular traffic for the entire period while the concrete is being cured.

(f.) **OPENING TO TRAFFIC.**—Upon the completion of curing operations as specified above, the pavement may be opened to traffic provided that beam tests show that the concrete has attained a modulus of rupture of at least five hundred (500) pounds per square inch. However, curing operations will not be considered completed unless a curing period of at least seven (7) days has elapsed since the concrete was placed.

MEASUREMENT AND PAYMENT

Cement concrete pavement will be measured by the cubic yard and the quantity to be paid for shall be the number of cubic yards, complete in place and accepted, as determined by the actual area of the finished pavement, and the depth as shown on the plans.

Cement concrete pavement will be paid for at the contract unit price per cubic yard under the item for Cement Concrete Pavement.

The above price shall include full compensation for furnishing all aggregates and cement; for mixing, placing, screeding, finishing, curing, and protecting concrete; for furnishing, placing, and removing forms; for forming and filling all joints and for all other labor, materials (except steel reinforcement) tools, supplies, equipment and incidentals necessary to complete the work, including sprinkling or treating the roadway to keep down dust or for the use of calcium chloride in the concrete mix.

PAYMENT ITEM

C 1-3 — Cement Concrete Pavement Cubic Yards

C1-4 AND 5 — ARTIFICIAL STONE SIDEWALKS AND DRIVEWAYS.

GENERAL

Artificial stone walks and driveways shall be constructed as shown on the plans and as directed, to the required lines and grades on a subbase of gravel, in accordance with these specifications.

MATERIALS

Gravel for subbase shall conform to the requirements of Section A.

Concrete for base course shall conform to the requirements contained herein and for Class B cement concrete.

The top or wearing surface shall conform to the requirements for air entrained Portland cement concrete and shall be composed by volume of one (1) part Portland cement and two and one-half ($2\frac{1}{2}$) parts of clean, sharp sand and lamp black mixed with only sufficient water to produce a plastic workable consistency.

CONSTRUCTION METHODS

The subgrade for the walk or driveway shall be shaped to a true surface conforming to the proposed cross section of the walk and thoroughly rolled and tamped. All depressions occurring shall be filled with suitable material and again rolled or tamped until the surface is smooth and hard.

SUBBASE. — After the subgrade has been prepared as hereinbefore specified, a subbase of gravel shall be placed upon it, which, after being wet and thoroughly rolled by power roller and tamped, shall be at least eight (8) inches in thickness for sidewalks and six (6) inches in thickness for driveways and for sidewalks four (4) inches below, and for driveways six (6) inches below and parallel to the proposed finished surface.

SUBBASE. — (for artificial stone replacement of existing sidewalks where existing subgrade is low). Sufficient gravel shall be placed upon the subbase so that the gravel after being thoroughly rolled (by power roller), and tamped, shall be four (4) inches for sidewalks and six (6) inches for driveways below and parallel to the proposed finished surface.

FORMS. — The forms shall be smooth, free from warp, of sufficient strength to resist springing out of shape and of a depth to conform to the thickness of the proposed walk. All mortar or dirt shall be completely removed from forms that have been previously used. The forms shall be well staked and thoroughly braced and set to the established lines with their upper edge conforming to the grade of the finished walk which shall have sufficient pitch from the outside to the edge of the walk to provide for surface drainage but which shall not exceed three-eighths ($\frac{3}{8}$) of an inch per foot.

The sidewalks and driveways are to be laid showing divisions of not less than twelve (12) square feet and of not more than thirty-six (36) square feet, as the Commissioner shall approve; all transverse joints shall be made by inserting a strip of wood between each block, three-quarters ($\frac{3}{4}$) inch thick by four (4) inches deep; each strip shall be removed just before the wearing surface is spread and the joint packed with fine, sharp sand; the joints to be smooth, straight, as small as possible, firm throughout their depth, and at right angles to the lines of the work, so that any block may be removed without injury to the adjoining block.

CONCRETE BASE COURSE.—On the subbase as specified above, a layer of concrete shall be placed in such quantity that after being thoroughly rammed in place it shall be three (3) inches in depth for sidewalks and five (5) inches in depth for driveways, and the surface shall be finished true, uniform, parallel with, and one (1) inch below the surface of the finished sidewalk or driveway.

In conveying the concrete from the place of mixing to the place of deposit, the operation must be conducted in such a manner that no mortar will be lost, and the concrete must be so handled that the base course will be of uniform composition throughout, showing neither excess nor lack of mortar in any one place.

The concrete materials shall be mixed to produce a concrete of such consistency that the water will flush to the surface under heavy tamping. Retempering of the concrete will not be permitted.

WEARING SURFACE. — The mortar for the wearing surface shall be mixed in a concrete mixer or ready mixed concrete and spread on the base immediately after mixing and shall be mixed to produce a mortar of a consistency which will not require tamping and which can easily be spread into position with a straightedge. In no case shall the wearing surface be placed after the base is set. After the wearing surface has been worked to an approximately true plane, the slab marking shall be made directly over the joint in the concrete base. Such marking shall be made with a tool which will cut approximately half way through the wearing surface, which shall be uniform in texture and appearances, and shall contain no tool marks or defacements of any type. In order to make certain that the top mark is directly over the sand joint a trowel shall be inserted through the top to the bottom of sand joint, so that when it is withdrawn it will show a coating of sand. On sidewalks between six (6) feet and eight (8) feet (inclusive) in width, a longitudinal scoring mark made with a V shaped tool shall be made on the finished surface, midway between the line of the back of edgestone and the line of the back of the sidewalk. For wider sidewalks, longitudinal scoring shall be as directed by the Engineer, but in no event shall the longitudinal scoring marks be more than five (5) feet apart. The wearing surface shall be one (1) inch in thickness and shall be finished by steel trowel and then lightly finished with wood float. The application of neat cement to the surface in order to hasten hardening is prohibited.

The finishing of concrete surface shall be done by experienced and competent cement finishers approved by the Commissioner.

When completed, the walk shall be kept moist and protected from traffic and weather for at least three (3) days. No concrete shall be mixed while the air temperature is below 33 degrees Fahrenheit. In no event shall concrete walks be laid on a frozen foundation.

WATER BOXES AND MANHOLE FRAMES. — Water boxes and manhole frames shall be carefully set to the proposed finished grade.

Gravel used in subbase of sidewalks and driveways shall be paid by tickets and measurement.

MEASUREMENTS AND PAYMENT

Artificial stone sidewalks and driveways will be measured complete in place and the area in square feet determined.

Artificial stone sidewalks and driveways will be paid for at the contract unit price, per square foot, complete in place. The unit price shall include all proper shaping and compacting of the subgrade, all forms, labor, material and equipment. Excavation of the existing sidewalks on streets done under Chapter 393 of the General Laws shall be the actual excavation as measured by the Engineer, and will be paid for under Item A2-1. In the reconstruction of streets, other than Chapter 393 streets, the excavation of existing walks which are to be replaced will be paid for under Item A2-1 and the excavation shall be calculated using the following fixed depths.

Any type existing sidewalks (except gravel) — four inches.

Any type existing driveways (except gravel) — six inches.

Existing gravel sidewalks — Actual depth measured.

Any unusual additional excavation required on these reconstructed streets, necessary because of poor subgrade conditions, shall be measured separately and added to total, figured on the fixed depth dimensions listed above.

PAYMENT ITEMS

C1-4 — Artificial Stone Sidewalks.....Square Foot

C1-5 — Artificial Stone Driveways.....Square Foot

C1-6 — FLAGSTONE WALKS

GENERAL.— Flagstone walks shall be constructed as shown on the plans and as directed to the required lines and grades on a subbase of gravel in accordance with these specifications.

MATERIALS

SUBBASE.— Gravel used shall be paid for under Item A3-1.

CONCRETE BASE COURSE.— Concrete for base course shall conform to the requirements for Class B Concrete.

WEARING SURFACE.— Flagstone wearing surface shall be structural slate as quarried at Middle Granville, New York; Pawlet, Vermont; Penn Argyll, Pennsylvania, or approved equal.

It shall be no less than one (1) inch nor more than one and one-half ($1\frac{1}{2}$) inches in thickness, and shall be no less than one (1) square foot in area.

MORTAR BED.— The mortar bed shall be composed of one (1) part Portland cement and two (2) parts of clean, sharp sand mixed with only sufficient water to produce a plastic workable consistency. The cement and sand for the mortar bed shall conform to the requirements for such materials, as hereinbefore specified.

CONSTRUCTION METHODS

SUBGRADE.— The subgrade for the walk shall be shaped to a true surface conforming to the proposed cross section of the walk and thoroughly rolled and tamped. All depressions occurring shall be filled with suitable material and again rolled or tamped until the surface is smooth and hard.

SUBBASE.— After the subgrade has been prepared as hereinbefore specified, a subbase of gravel shall be placed upon it, which, after being wet and thoroughly rolled and tamped, shall be at least eight (8) inches in thickness and five (5) inches below and parallel to the proposed finished surface of the walk.

FORMS.— The forms shall be smooth, free from warp, of sufficient strength to resist springing out of shape and of a depth to conform to the thickness of the proposed walk. All mortar or dirt shall be completely removed from forms that have been previously used. The forms shall be well staked and thoroughly braced and set to the established lines with their upper edge conforming to the grade of the finished walk which shall have sufficient pitch from the outside to the edge of the walk to provide for surface drainage but which shall not exceed three-eighths ($\frac{3}{8}$) of an inch per foot.

CONCRETE BASE COURSE.— On the subbase as specified above, a layer of concrete shall be placed in such quantity that after being thoroughly rammed in place it shall be three (3) inches in depth and the surface shall be finished true, uniform, parallel with, and two (2) inches below the surface of the finished sidewalk.

In conveying the concrete from the place of mixing to the place of deposit, the operation must be conducted in such a manner that no mortar will be lost, and the concrete must be so handled that the base course will be of uniform composition throughout, showing neither excess nor lack of mortar in any one place.

The concrete materials shall be mixed to produce a concrete of such consistency that the water will flush to the surface under heavy tamping. Retempering of the concrete will not be permitted.

The mortar bed for the wearing surface shall be mixed in a concrete mixer, or ready-mixed concrete and spread on the base immediately after mixing and shall be mixed to produce a mortar of a consistency which will not require tamping and which can easily be spread into position. In no case shall the flagstone wearing surface be placed after the mortar bed has set.

Flagstones shall be so selected, and if necessary edges shall be trimmed, so that in no case shall joints between flagstones occur which will be wider than one (1) inch. Flagstones shall be so selected that after laying, the entire pattern shall be varicolored and of a pattern satisfactory to the Commissioner. After the mortar bed has been placed, the flagstone wearing surface shall be laid and worked to an approximate true plane. The placing of the flagstone wearing surface shall cause the displacement of sufficient of the mortar bed so as to fill the spaces between the individual flagstones even with the top surface of the walk. After the flagstone has been placed all excess mortar shall be removed, by flushing or other suitable method, so as to leave the flagstone wearing surface free from excess mortar or discoloration, formed therefrom.

MEASUREMENT AND PAYMENT

Flagstone walks will be measured complete in place, and the area in square feet determined.

Flagstone walks will be paid for at the contract unit price per square foot, complete in place. This price shall include the shaping and compacting of the subgrade, flagstone furnished and set, furnishing and installing concrete base, mortar joints and all incidental labor and material necessary to complete the work.

PAYMENT ITEM

C 1-6 — Flagstone Walk..... Square Foot

C1-7 — LOAM AND SEEDING

GENERAL

The work to be done under this Item consists of furnishing and placing loam on approved subgrades and seeding such loamed areas where and as directed, whether the areas are sidewalk spaces, back of sidewalks or slopes.

MATERIALS

Loam shall be from grass or pasture land, rich and fibrous, and shall be free from stumps, tree roots and other objectionable substances.

Seed shall be first quality lawn grass seed of the previous year's crop, and of a mixture and quantity directed by the Commissioner.

CONSTRUCTION METHODS

Loam shall be deposited on approved subgrades, thoroughly spaded and raked so as to remove all objectionable material, and sufficient in quantity to bring the surface to the form and grade required when the work thereon is completed.

Subgrades for sidewalk loam spaces shall be six (6) inches below the finished surface of the loam spaces.

All loam shall be sufficiently seeded and watered to insure a satisfactory growth of grass, advantage being taken of favorable weather and season of the year for seeding. The seed shall be raked in and the loam thoroughly rolled by hand roller.

MEASUREMENT AND PAYMENT

Loam will be measured by tickets delivered with each load and/or such other acceptable method as the Commissioner may direct. Tickets shall be signed by a City Inspector.

Payment for loam will be made at the contract unit price per cubic yard, complete in place, including grading, loaming, and seeding and all labor, material and equipment required to complete the work.

PAYMENT ITEM

C1-7 — Loam and Seeding..... Cubic Yard

SECTION C-2

BITUMINOUS CONCRETE

SECTIONS D & E

DRAINAGE MISCELLANEOUS

C 2-1 — BITUMINOUS CONCRETE BASE COURSE

GENERAL

The bituminous concrete base mixture shall be composed of mineral aggregate and bituminous material, plant mixed and laid hot. The base course shall be constructed in one or more courses as directed upon the prepared or existing subgrade or subbase.

MATERIALS

The blended mineral aggregate prepared as detailed hereinafter shall be graded and combined to meet the following composition limits by weight:

MATERIAL	STANDARD SIEVES		PER CENT BY WEIGHT	
			BASE COURSE	
	Passing	Retained	Minimum	Maximum
*Coarse Aggregate	7/8 inch	7/8 inch	30	0
	1/2 inch	1/2 inch	15	50*
	No. 4	No. 4	5	30
		No. 10		15
Fine Aggregate	No. 10	No. 20	2	8
and	No. 20	No. 40	4	10
Mineral	No. 40	No. 80	4	10
Filler	No. 80	No. 200	2	6
	No. 200		1	4
Bitumen (Sol. in CS ₂)			4½	5½
TOTAL				100
Total (FAG and MF)			20	30

* Not more than one-fifth of the 7/8-inch to 1/2-inch fraction in the base course shall be retained on a 3/4-inch sieve.

MINERAL AGGREGATE.—The coarse aggregate shall be considered to be that portion retained on a No. 10 sieve. It shall be clean, crushed rock consisting of the angular fragments obtained by breaking and crushing solid or shattered natural rock, free from thin or elongated pieces, dirt and other objectional material; and the use of crushed gravel stone will not be permitted. It shall be surface dry and shall have a moisture content of not over one per cent. The rock shall have a percentage of wear as determined by the Los Angeles Abrasion Test (A.A.S.H.O. Standard Method T96-49) of not more than 30.

The fine mineral aggregate shall consist of sand or a mixture of sand and stone screenings of which at least 50 per cent shall be sand. The sand shall consist of clean, hard, durable grains free from clay, loam or other foreign matter. It shall meet the following grading requirements:

Passing 3/8-inch sieve 95% minimum
 Passing No. 10 sieve 85 % minimum

The sand shall be pre-screened through a one-half inch maximum sieve to remove large gravel and meet the above requirements. The stone screenings shall be the product of a secondary crusher and shall be free from dirt, clay, organic matter, excess fines or other deleterious material.

MINERAL FILLER.—Mineral filler shall consist of approved Portland cement, limestone dust, or approved stone dust. Stone dust shall be produced from crushed ledge stone which shall be hydrophobic and shall be the product of a secondary crusher so processed as to deliver a product of uniform grading. Mineral filler shall completely pass a No. 40 sieve and at least 65 per cent shall pass a No. 200 sieve.

MIXTURE.—The asphalt cement for the mixture shall conform to the requirements of Designation M 20-42 of the A.A.S.H.O. for penetration of 85-100 or 100-120 (Department of Public Works Specification OA-3 or OA-4 Commonwealth of Massachusetts) as specified by Commissioner.

TACK COAT.—Bituminous material for the tack coat on the present surface, where required shall consist of either emulsified asphalt or cut-back asphalt conforming to the following specifications:

EMULSIFIED ASPHALT.—This bitumen shall conform to the A.A.S.H.O. Designation M 140-49, Type RS-1 except that the Demulsibility (35m1/0.02N Ca) shall be not less than 50 per cent.

See Subsection C2-5 for CONSTRUCTION METHODS and MEASUREMENT AND PAYMENT.

C 2-2 — BITUMINOUS CONCRETE WEARING SURFACE

(Class I Type I-1)

GENERAL

This type of pavement shall be composed of mineral aggregate, mineral filler and bituminous material, plant mixed and laid hot. The pavement shall be constructed in one (1) course or as directed on the prepared or existing base in accordance with these specifications and in conformity with the lines, grades and typical cross section shown on the plans, or as specified in the Special Provisions.

MATERIALS

The blended mineral aggregate, prepared as detailed hereinafter, shall be graded and combined to meet the following composition limits by weight:

MATERIAL	STANDARD SIEVES		PER CENT BY WEIGHT	
			TOP COURSE	
	Passing	Retained	Minimum	Maximum
Coarse Aggregate	7/8 inch 1/2 inch No. 4	7/8 inch 1/2 inch No. 4 No. 10	25 15	0 40 25
Fine Aggregate	No. 10	No. 20	4	12
and	No. 20	No. 40	6	16
Mineral	No. 40	No. 80	6	16
Filler	No. 80	No. 200	4	10
	No. 200		4	6
Bitumen (Sol.) (in CS ₂)			6	7
TOTAL				100
Total (FAG and MF)			35	45

* Not more than 1/4 of the 1/2-inch to No. 4 fraction in the top course shall be retained on a 3/8-inch sieve.

Sufficient approved mineral filler shall be used to correct deficiencies in grading of fine aggregate for the Standard Top Course Mix but in no case shall less than two per cent of the total consist of mineral filler. Job mix formula containing less than two per cent of mineral filler separately proportioned for the aforesaid mixes will not be approved.

FORMULA FOR JOB MIX. — The composition limits prescribed above are master ranges of tolerances for materials in general. In order to obtain standard texture, density, and stability, the Commissioner shall submit to the Contractor a specification job mix formula for the specific materials to be used on each project. The job mix formula shall specify the per cent of coarse aggregate, fine aggregate mineral filler, asphalt content and the temperature of mix when delivered on the job. The Contractor shall be responsible for controlling the mix within the following tolerances of the job mix specifications:

	Job Average	Single Maximum
Asphalt.....	25%	50%
Aggregate		
Passing No. 10.....	2.5%	5.0%
Passing No. 200.....	1.0%	2.0%
Specified delivery temperature on job.....	15°	25°

The Commissioner may require the Contractor to replace at his own expense any defective mix not meeting the specified tolerances of the job mix formula, on the basis of the Department tests. Samples of the actual mixture in use will be taken as many times daily as necessary and the mixture must be maintained uniform throughout the project within the above tolerances. If an additional source of supply for materials is approved, the job mix formula will be readjusted as necessary. Any job mix formula submitted but found unacceptable shall be readjusted to the satisfaction of the Commissioner.

Job materials found to have voids or other characteristics requiring, for a balanced mix, a bitumen content greater or less than the bitumen content range above tabulated will be rejected.

The Commissioner may suspend further approval for use of the plant if the mix is not uniformly controlled as specified until necessary changes are made to meet the requirements.

DEPTH OF COURSE. — The bituminous concrete shall be laid in one (1) course with a finished pavement depth after rolling of one and one-quarter ($1\frac{1}{4}$) inches.

MINERAL AGGREGATE. — The coarse aggregate shall be considered to be that portion retained on a No. 10 sieve. It shall be clean, crushed rock consisting of the angular fragments obtained by breaking and crushing solid or shattered natural rock, free from thin or elongated pieces, dirt and other objectional material; and the use of crushed gravel stone will not be permitted. It shall be surface dry and shall have a moisture content of not over one per cent. The rock shall have a percentage of wear as determined by the Los Angeles Abrasion Test (A.A.S.H.O. Standard Method T96) of not more than 30.

The fine mineral aggregate shall consist of sand or a mixture of sand and stone screenings of which at least 50 per cent shall be sand. The sand shall consist of clean, hard, durable grains free from clay, loam or other foreign matter. It shall meet the following grading requirements:

Passing $\frac{3}{8}$ -inch sieve.....	95% minimum
Passing No. 10 sieve.....	85% minimum

The sand shall be pre-screened through a one-half inch maximum sieve to remove large gravel and meet the above requirements. The stone screenings shall be the product of a secondary crusher and shall be free from dirt, clay, organic matter, excess fines or other deleterious material.

MINERAL FILLER. — Mineral filler shall consist of approved Portland cement, limestone dust, or approved stone dust. Stone dust shall be produced from crushed ledge stone which shall be hydrophobic and shall be the product of a secondary crusher so processed as to deliver a product of uniform grading. Mineral filler shall completely pass a No. 40 sieve and at least 65 per cent shall pass a No. 200 sieve.

BITUMINOUS MATERIALS.

A. MIXTURE. — The asphalt cement for the mixture shall conform to the requirements of Designation M20-42 of the A.A.S.H.O. for penetration of 85-100 or 100-120 (Department of Public Works Specification, Commonwealth of Massachusetts OA-3 or OA-4) as specified by Commissioner.

B. TACK COAT. — Bituminous material for the tack coat on the present surface, where required, shall consist of either emulsified asphalt or cut-back asphalt conforming to the following specifications:

1. EMULSIFIED ASPHALT. — This bitumen shall conform to the A.A.S.H.O. Designation M140-49, Type RS-1 except that the Demulsibility (35ml/0.02N Ca Cl₂) shall be not less than 50 percent.

2. CUT-BACK ASPHALT. — Cut-back asphalt shall conform to the requirements of the Commonwealth of Massachusetts, Department of Public Works Specifications RC-1 or RC-2 as required.

See Subsection C2-5 for CONSTRUCTION METHODS and MEASUREMENT AND PAYMENT.

C2-3 & 4 — BITUMINOUS CONCRETE SIDEWALKS AND DRIVEWAYS

GENERAL

The bituminous concrete sidewalks and driveways shall be composed of mineral aggregate, mineral filler and bituminous material, plant mixed and laid hot. The sidewalk shall be constructed in two (2) courses on a gravel base and in accordance with the lines and grades given by the Engineer.

The general composition of the mixture shall conform to the respective requirements for base course and top course as hereinbefore specified for bituminous concrete roadway pavement.

The formula for the job mix shall conform to the requirements specified under Bituminous Concrete Wearing Surface.

The bituminous concrete sidewalk shall be laid in two (2) courses with a finished depth after rolling of two and one-half (2½) inches. The base course shall be one and one-quarter (1¼) inches in thickness and its surface after rolling shall be one and one-quarter (1¼) inches below and parallel to the proposed grade of the finished sidewalk. The top course shall be one and one-quarter (1¼) inches in thickness after rolling.

MATERIALS

Mineral aggregate, mineral filler and asphalt cement shall conform to the respective requirements for base course and top course as hereinbefore specified for bituminous concrete roadway pavement.

CONSTRUCTION METHODS

The subgrade shall be shaped to the true surface conforming to the proposed cross section of the sidewalk or driveway and thoroughly rolled and tamped until the surface is smooth and hard.

After the subgrade has been prepared as hereinbefore specified a subbase of gravel shall be placed upon it which after being thoroughly rolled shall be at least four (4) inches thick and two and one-half (2½) inches below and parallel to the proposed finished surface of the sidewalk or driveway.

Where existing defective bituminous concrete sidewalks and driveways are to be replaced, the contractor will be required to excavate and remove the existing material to a depth of 6½ inches below and parallel to the proposed finished surface of the sidewalk or driveway.

Where no headers, curbing or other suitable permanent supports are provided, satisfactory forms shall be installed to assist in securing proper alignment and adequate compaction of the base and surface course.

The surface shall be rolled with a self-propelled equally balanced tandem roller weighing not less than one and one-half (1½) tons and not more than five (5) tons.

In places inaccessible to a power roller compaction shall be obtained by means of hand tampers.

The plant requirements, care and transportation of mixture and general conditions set forth hereinafter shall be applicable to bituminous concrete sidewalk construction.

When tested with a ten (10) foot straightedge placed parallel to the center line of the surface course there shall be no deviation from a true surface in excess of one-quarter ($\frac{1}{4}$) of an inch. If at any time before the acceptance of the work, any soft or imperfect places or spots shall develop in the surface, all such places shall be removed and replaced with new material and then rolled until the edges at which the new work connects with the old become invisible. All such removal and replacement of unsatisfactory surfacing shall be done by the Contractor without additional compensation.

See Subsection C2-5 for additional applicable CONSTRUCTION METHODS, and MEASUREMENT AND PAYMENT.

C2-5 — SHEET ASPHALT WEARING SURFACE

GENERAL. — This pavement shall be composed of mineral aggregate, mineral filler and bituminous material, plant mixed and laid hot. The pavement shall be constructed in one (1) course or as directed on the prepared or existing base in accordance with these specifications.

COMPOSITION. — The blended mineral aggregate, prepared as detailed hereinafter, shall be graded and combined to meet the following composition limits by weight:

SQUARE-OPENING SIEVES										PER CENT BY WEIGHT			
Passing										Retained On		Minimum	Maximum
1 inch										3/4-inch 1/2-inch			
1 inch													
3/4-inch													
1/2-inch													
No. 4	. . . . .									No. 4			
No. 10	. . . . .									No. 10			
No. 8	. . . . .										0		5
No. 10	. . . . .									No. 20	2		12
No. 20	. . . . .									No. 30	4		12
No. 30	. . . . .									No. 40	4		20
No. 10										No. 40	10		35
No. 40										No. 50	4		25
No. 50										No. 80	4		35
No. 40										No. 80	15		50
No. 80										No. 200	10		35
No. 200											10		
Nos. 80 and 200											25		
Bitumen (Sol. in CS ₂)											10		12

At least six (6) per cent of the mixture shall be approved mineral filler, and the proportions of all the ingredients used must give the densest pavement possible within the limits of the above sieve analysis, and the mixture must be capable of being compressed (without breaking the sand grains of its composition) into a pavement having a specific gravity of about two and two-tenths (2.2) at 77 degrees Fahrenheit, the intent being a close, dense, waterproof pavement.

The minimum quantity of bitumen shall be used only in mixtures containing the minimum total passing the 80-mesh sieve, and the percentage of bitumen shall be increased above the minimum as the total passing the 80-mesh sieve increases.

FORMULA FOR JOB MIX. — The formula for job mix shall conform to the requirements for bituminous concrete wearing surface, except that the material shall meet the exact formula thus set-up for the contract within the following allowable job tolerances:

	Plus or Minus
Asphalt	0.5%
Aggregates (No. 4 sieve and larger)	2.0%
Aggregates (No. 200 sieve and larger)	2.0%
Aggregates (No. 200 sieve and smaller)	1.5%
Delivery Temperature	20° F.

DEPTH OF COURSES. — The sheet asphalt shall be laid in one (1) course with a finished pavement depth after rolling of one and one-half ($1\frac{1}{2}$) inches.

MATERIALS

Mineral aggregate and mineral filler shall conform to the respective requirements for base course and top course as hereinbefore specified for bituminous concrete roadway pavement.

Asphalt cement shall conform to the requirements of Specifications M-20-26 of the A.A.S.H.O. for 85 to 100 penetration.

CONSTRUCTION METHODS

PLANT REQUIREMENTS

The paving plant used by the Contractor in the preparation of the bituminous concrete shall comply with the following requirements:

PLANT CAPACITY. — To prevent delay and an unnecessary number of joints resulting from intermittent or interrupted operations, the Contractor, if required, shall adjust his plant and operations so as to deliver material at a continuous rate for at least 40 tons per hour.

The plant shall be given a rated maximum capacity per hour, based upon the mixture specified hereinbefore and governed by the size of mixer and area of screens. This rated hourly capacity may be varied by the Engineer when necessary to insure adequate control of the mixture.

FEEDING DEVICES. — All plants shall be equipped with an approved adjustable automatic device for feeding the mineral aggregate onto the cold elevator of the paving plant at a uniform rate.

The cold aggregate shall be stored in bins in an approved number of separate sizes in order to regulate and control the feed to the dryer to meet the formula requirements without delays or shut-down. If two different sources or gradings of fine aggregates are used, they shall be separately proportioned in an approved manner.

DRYING UNIT. — The mixing plant shall have a cylindrical drying unit equipped with flights for elevating and dropping the aggregate through the hot gases. The drier shall be capable of heating the aggregate to the temperature specified at the rate required to meet the capacity of the plant. The minimum diameter of a single drier shall be 54 inches and the length shall be such that the volume of the drier shall be not less than 300 cubic feet.

The drier shall be internally heated with hot gases from a combustion chamber, or it may be externally heated provided that the hot gases are finally carried through the drier. Gases and warm air shall be forced through the drier, and steam from the heated aggregate removed, by means of an adequate exhaust fan. After drying, when cooling of the aggregate is required, the combined drying and cooling system shall consist of one or more rotating cylinders so designed as to produce aggregate in accordance with the requirements of the specifications to the full rated capacity of the plant. Mix plant float recovered from dust collector shall not be returned to the aggregate except under closely regulated control meeting the Engineer's approval.

SCREENING. — The plant shall be equipped with an enclosed bucket elevator for raising the heated aggregates from the discharge chute of the drier to the screens and bins. The capacity of this bucket elevator shall be at least 25 per cent greater than the rated capacity of the drying unit.

The screens shall be of the vibrating or rotary type capable of dividing the aggregate into four or more sizes and with provision for rejecting all over-size particles. Where vibrating screens are used, the screen on which the aggregate is first deposited shall have a guaranteed minimum capacity of 50 tons per hour and the smallest section of the screen shall have an area of not less than 16 square feet. For increased rating or allowable hourly production, the screening area shall be increased. Other screen sections may have a reduced capacity only as the percentage of material to be handled is decreased.

Rotary screens shall be the jacketed type having an inner scalper screen and shall have the following minimum dimensions. The diameter of the inner (full length) screen shall be not less than 45 inches, shall contain not more than two sections and each section shall have an area of not less than 45 square feet and a length of not less than 4 feet. The outer jacket shall extend the full length of the screen, shall contain not more than two sections and the jacket shall be at least 10 inches greater in diameter than the inner jacket. The scalper screen shall have a maximum diameter of 10 inches less than the inner screen and shall be not less than 36 inches long. The screen sections shall be so arranged that the mineral aggregate is first deposited on the scalper screen and that portion passing through the scalper shall not first come in contact with the smallest mesh screen.

The requirements set forth above are minimum allowable dimensions and a screen area of 45 square feet for the smallest section shall permit an hourly production of 40 tons. For increased hourly rates the screen sections shall show a proportionately larger area.

The sizes of screen openings for each separation shall be subject to the approval of the Engineer.

BINS. — The plant shall have bins for the storage of the screened hot aggregate and the combined capacity shall be not less than 20 cubic yards. The bins shall consist of not less than four separate compartments corresponding to the screen separations and with a cubical content approximating the percentage of each size of aggregate required to be used in the mixture.

Each bin shall be equipped with an overflow chute placed so as to prevent overflow from one bin to another, or in lieu of overflow chutes an electric signal device may be used which shall register on a central signal board when each bin becomes filled.

WEIGH BOX. — The plant shall have a weigh box of sufficient capacity to hold one ton of the aggregate. The weigh box or hopper shall be supported on fulcrums and knife edges so constructed that they will not be easily thrown out of alignment or adjustment. Said weighing hoppers must be free from contact on all edges, ends or sides with any supporting rods or columns or other equipment which will in any way affect its proper functioning. In addition, there must be sufficient clearance between the hopper and the supporting devices so that foreign materials will not accumulate. The discharge gate of the weigh box shall be hung so that the aggregate will not be segregated when dumped into the mixer. If it becomes necessary to correct any such tendency, baffles shall be inserted or other means provided to discharge the materials in a blended condition.

The weigh box may be of the dump bottom or chute type, having a width of not more than 3½ feet, and if a chute is used, it shall have a width of not more than one foot.

Scales for the weigh box may be of either the beam or the springless dial type and shall be of a standard make and design, sensitive to 0.50 per cent of the maximum load which may be required. Beam type scales shall have a separate beam for each size of aggregate and there shall be a "telltale" dial scale attached which will start to function when the load being applied is within 100 pounds of that desired. Sufficient vertical movements shall be provided for the beams to permit the "telltale" dial scale to function properly. Each beam shall have a locking device designed and so located that the beam can easily be suspended or thrown into action. Beam scales shall be balanced on knife edges and fulcrums and be so constructed that they cannot be easily thrown out of alignment and adjustment.

Dial scales shall be of a standard make and of such size that the numerals on the dial can be read at a distance of not less than 25 feet. The dials shall be of the compounding type having full complement of index pointers. Any pointers so placed as to give excessive parallax errors shall not be used.

They shall be substantially constructed, and makes of this type scale which easily get out of adjustment shall be replaced with other makes when so ordered. All dial scales shall be so located that they will be in plain view of the operator at all times.

MIXER.— The mixer shall be a batch mixer of the standard twin pug mill type, steam jacketed, equipped with a sufficient number of paddles or blades and set in proper order to produce properly mixed batches of any materials required under these specifications. When the clearance in the twin pug type becomes equal to or exceeds two inches, either the shortened blades of the worn liners (or both) shall be replaced to reduce the clearance to two inches or less. When it becomes difficult to secure proper mixing in the specified mixing time, the Engineer may require that the mixers be provided with an approved accurate time lock that will lock the discharge gates of the weigh box after all the aggregates have been placed in the mixer, and which will not release the gates until the specified time has elapsed. For the minimum mixing time of 45 seconds, the mixer capacity shall be at least 2,000 pounds.

The mixer shall have a volume of not less than 52 cubic feet. The mixer gate shall be power operated by means of a steam ram.

The top of the mixer shall be equipped with suitable baffles, cover plates, or a hinged perforated cover which shall insure uniform distribution of the asphalt when it is introduced into the mixer.

ASPHALT CONTROL UNIT.— Satisfactory and approved means, either by weight, metering or volumetric measurements, shall be provided to obtain the proper amount of bituminous material in the mix. All measuring devices shall be sensitive to two per cent tolerance above or below the amount of bituminous material required for a batch. Suitable means shall be provided, either by steam jacketing or other insulation, for maintaining the specified temperatures of the bituminous materials in the pipe lines, meters, weigh buckets, spray bars and other containers or flow lines.

If an asphalt bucket is used, it shall have a capacity equal to 10 per cent of the maximum capacity of the mixer. It shall be supported on fulcrums and knife edges in the same manner as the weigh box.

Scales for the weighing of asphalt cement shall conform to the specifications for the aggregate scales except that beam scales shall be equipped with a tare beam and a full capacity beam. The value of the minimum graduation in any case shall not be greater than two pounds. Dial scales for weighing asphalt cement shall not have a capacity of more than twice the weight of the material to be weighed and shall read to the nearest pound. If it becomes necessary the supports for asphalt scales and bucket shall be separate from the tower or the structural parts of the mixing plant, in order that vibration shall not interfere with accurate reading of the scales. The scales shall also have a device for reading over and under weight.

The Contractor shall provide and have at hand the necessary number of standard test weights for frequent testing of all scales.

The weighing equipment, in addition to complying with the above requirements, must be constructed with the necessary adjustable devices which will permit any part thereof to be easily realigned or readjusted so that the weighing devices will function properly.

ASPHALT STORAGE.— Kettles for storage of asphalt cement shall have a total capacity of not less than 4,500 gallons and shall permit heating of the asphalt cement to a temperature of between 275 degrees Fahrenheit and 325 degrees Fahrenheit, with the effective and positive control of the heat at all times.

Under no circumstances shall a direct flame from oil or other fuel be permitted to come in direct contact with the heating kettles. The asphalt circulating system shall be constructed of adequate size in order to allow the proper and continuous circulation of the asphalt cement throughout the operating periods. All asphalt lines and fittings shall be steam heated.

TEMPERATURE CONTROL.— The plant shall be equipped with an approved dial scale mercury actuated thermometer, and electric pyrometer or other approved thermometric instrument so placed at the discharge chute of the drier as to register automatically the temperature of the heated aggregates. This device shall also be in full view of the drum fireman or head feeder.

The Engineer will reserve the right to pass upon the efficiency of the above instrument and, in order to obtain better regulation of the temperature of the aggregates, he may direct the replacement of the instrument by some approved temperature-recording apparatus and he may further require that a daily chart of said regulator be filed with him.

HANDLING FILLER.— The mineral filler shall be stored in an overhead bin and shall be discharged in the weigh box in a controlled manner approved by the Engineer.

TESTING EQUIPMENT AND FACILITIES.— The Engineer or his authorized representative shall have access at any time to all parts of the paving plant for verification of weights or proportions and character of materials and determinations of temperatures used in the preparation of the mixture.

The Contractor shall provide and maintain in good order at the plant the following testing equipment which may be used by the Engineer, or inspector designated by him, to determine the grading of the mineral aggregate and for such other tests as are deemed as necessary:

- 1 Approved Rotary Bituminous Extractor.
- 1 Set of Standard Sieves. Nos. 10, 20, 40, 80 and 200.
- 1 Set of Standard Sieves. $7/8"$, $3/4"$, $1/2"$, No. 4, with square openings.
- 1 Set of Scales.
- 2 Armored Thermometers.

All of the aforesaid apparatus shall be of approved standard type, and it shall be properly housed in a separate building or room not less than 10 feet by 10 feet, provided with a work bench. This room shall be used exclusively for testing purposes by the Contractor and the Engineer or his inspector.

PREPARATION OF MIXTURE

PREPARATION OF ASPHALT CEMENT.— The bituminous material shall be melted in kettles or tanks designed to secure uniform heating of the entire contents. The material shall be heated to a temperature between 275 degrees Fahrenheit to 325 degrees Fahrenheit.

PREPARATION OF MINERAL AGGREGATE.— The aggregates for the mixture shall be dried and heated at the paving plant before entering the mixer. The aggregates shall be heated to a temperature between 275 degrees Fahrenheit and 325 degrees Fahrenheit as determined on the mixing platform. When more than two ingredients enter into the composition of the mineral aggregate they shall be combined as directed by the Engineer.

The aggregates, immediately after heating, shall be screened into four or more sizes and conveyed into separate bins, ready for batching and mixing with bituminous material. The aggregates shall be separately proportioned in not less than three different approved sizes for top course or dense mix. Provisions shall be made for adequate storage of mineral filler. This material shall be weighed on approved scales before introduction into the mixer with the mineral aggregate.

PREPARATION OF MIXTURE.— The mineral filler and the dried mineral aggregate prepared as above prescribed shall be combined in uniform batches by weighing and conveying into the mixer the proportionate amounts of each aggregate required to meet the job mix formula. The required quantity of hot asphalt cement for each batch shall be measured by weight using scales attached to the asphalt cement bucket. An asphalt fluidometer may be used at Contractor's responsibility if previously calibrated and approved by the Engineer. The mixture shall be made by first charging the mixer with the mineral aggregate and mineral filler. After these have been thoroughly mixed the asphalt cement shall be added and the mixing continued for a period of at least 45 seconds, or longer if necessary, to produce a homogeneous mixture in which all particles of the mineral aggregate are uniformly coated. Each batch must be kept separate throughout the heating and mixing operations.

The ingredients shall be heated and combined in such a manner as to produce a mixture which shall be at a temperature, when discharged, of not more than 325 degrees Fahrenheit.

TRANSPORTATION OF MIXTURE

GENERAL.— The paving mixture must be kept clean during hauling and handling and covered during transit with canvas or other materials which will retain the desired pavement temperature.

These mixtures shall not be hauled such a distance that segregation of the ingredients takes place or that a crust is formed on the surface, bottoms or sides of said mixture which will not crumble or flatten out when dumped.

The vehicles for transporting the mixture shall be tight and the inside of the bodies shall be coated with a thin soluble oil.

The dispatching of motor trucks from the plant or distribution point shall be so arranged that all material which is to be delivered at or on the road surface during any day may be placed and shall have received final compression before nightfall of the same day.

CHARACTER OF BITUMEN FOUND IN THE MIXTURE AFTER FLOATING. — Samples approximately 12 inches square for the full depth of the course being laid will be taken from the mixture incorporated in the work after the finishing operations have been completed and the pavement has cooled. Not less than one sample shall be taken from each 3,000 tons of bituminous concrete mixture and as many more may be taken as shall be deemed necessary by the Engineer. At least one such sample shall be taken from each project containing 150 or more tons of mixture.

The bituminous mixture and the labor for taking these samples in the field shall be furnished without charge by the Contractor.

Tests will be conducted by the Department. The bitumen shall be extracted from the samples in accordance with "Method and Apparatus for the Recovery of Asphalt," by Gene Abson described in the 1933 Proceedings of the American Society for Testing Materials, Vol. 33, page 704, or other approved methods of recovery. The bitumen extracted shall not decrease in penetration more than 50 per cent of the original material before its incorporation in the mixture and it shall not decrease in ductility to less than 40 centimeters.

WORK ON ROADWAY

SPREADING AND FINISHING EQUIPMENT. — The equipment for spreading and finishing shall be approved mechanical, self-powered pavers, capable of spreading the mixture true to line, grade and crown required.

The pavers shall be equipped with hoppers and distributing screws of the reversing type to place the mixture evenly in front of adjustable screeds. They shall be equipped with a quick and efficient steering device and shall have reverse as well as forward traveling speeds.

The pavers shall employ mechanical devices such as equalizing runners, straight-edge runners, eveners or other compensating devices to adjust the grade and confine the edges of the mixture to true lines. They shall be capable of spreading the mixture without segregation, in layers to the depths and widths required. They shall be equipped with blending or joint leveling devices for smoothing and adjusting all longitudinal joints between adjacent strips or courses of the same thickness.

The term "screed" includes any "strike off" device operated by cutting, crowding, or other practicable action, which is effective on the mixtures at permissible workable temperatures without tearing, shoving or gouging, and which produces a finished surface of the evenness and texture required. The screed shall be adjustable for profile and shall have an indicating level attached.

An approved device will be required for heating the screed to the temperature required for the laying of the mixtures without pulling or marring.

If during construction it is found that the spreading and finishing equipment in operation leaves in the pavement tracks or indented areas, which are not satisfactorily corrected by the scheduled operations, or which produces other permanent blemishes, the use of such equipment shall be discontinued and other satisfactory spreading and finishing equipment shall be provided by the Contractor.

TACK COAT. — When it is required that the existing hardened surface shall be utilized as a base for the new pavement, a tack coat of bituminous material of the kind and grade shown on the plans or specified in the Special Provisions shall be uniformly applied to the present surface, at the rate of application as indicated on the plans or as directed by the Commissioner, immediately prior to laying the bottom course of the new pavement.

The present surface shall be cleaned of all foreign matter and loose material and shall be dry before the tack coat is placed.

SPREADING MIXTURES. — The mixture shall be delivered and placed only at such times as to permit the proper inspection and checking by the Commissioner.

The mixture shall be delivered to the work in such condition that it can be efficiently placed by the methods prescribed below. Unless otherwise permitted by the Commissioner machine methods of spreading shall be used.

The mixture shall be placed only upon an approved, dry course and only when weather conditions are suitable. No mixture shall be placed when the air temperature in the shade and away from artificial heat is 35 degrees Fahrenheit or less, except by written permission of the Commissioner.

The bituminous concrete shall be laid in two courses with a finished pavement depth after rolling of $2\frac{1}{2}$ inches. The bottom course shall be $1\frac{1}{4}$ inches in thickness, and its surface after rolling shall be $1\frac{1}{4}$ inches below and parallel to the proposed grade of the finished surface. The top course as specified shall be $1\frac{1}{4}$ inches in thickness after rolling. Where an existing base contains irregularities of more than one inch such irregularities shall be eliminated by the use of extra bottom course material bringing the existing base to uniform section and grade.

The new bottom course shall be clean when the top course is applied. Any accumulation of dirt, leaves or other foreign matter shall be completely removed previous to application of the top course.

Contact surfaces of curbing, gutters, manholes, etc., shall be painted with a thin uniform grade of bitumen (Department Specification RC-2 or RS-2), just before the mixture is placed against them.

The edges of the asphalt mixture adjacent to rigid curb lines, around manholes or other solid fixtures, shall be hand tamped before being rolled.

Special attention shall be given to testing the surface of each course with a straight edge. Immediately following initial rolling the surface of the finished pavement shall have an even and uniform appearance throughout.

The methods of spreading the bituminous concrete mixture shall be as follows:

1. **MACHINE SPREADING.** — All mixtures shall be deposited in an approved mechanical spreader and immediately spread thereby, and struck off in a uniform loose layer to the full width required and of such depth that each course, when compacted, shall have the required thickness and shall conform to the grade and cross-section contour specified.

The mixture shall be deposited in the center of the hoppers, and care exercised to avoid overloading and spilling. The pavers shall operate, while the mixture is being spread, at a speed which will produce a uniform surface texture.

Immediately after any course is screeded, and before roller compaction is started, the surface shall be checked, any inequalities adjusted, any sandy accumulation from the screed removed by rake or hoe, and all fat spots in any course removed and replaced with satisfactory material. Irregularities in alignment and grade along outside edges shall be corrected by the addition or removal of mixture before the edges are rolled.

Unless otherwise directed by the Commissioner, spreading operations shall be so conducted that the full width of pavement will have been properly spread and rolled at the end of each day's operation. All edges shall be left true and uniform.

2. **HAND SPREADING.** — Spreading by hand methods will be permitted only for special stretches or areas which, because of irregularity, inaccessibility, or other unavoidable obstacles, do not allow mechanical spreading and finishing.

When hand spreading is permitted the mixture shall be dumped, upon arrival, outside the area in which it is to be spread. Immediately thereafter, it shall be distributed into place by means of hot shovels, and spread with hot rakes in a loose layer of uniform density and correct depth. Tines of the rakes shall be not less than one-half inch longer than the loose depth of mixture and spaces between tines shall be not less than one inch. Loads shall not be dumped any faster than they can be properly handled by the shovelers and the shovelers shall not distribute the dumped load faster than it can be properly handled by the rakers. The raking shall be carefully and skillfully done to avoid segregation and so that, after the first passage of the roller over the raked mixture, a minimum amount of back patching will be required.

METHOD OF COMPACTING. — After the paving mixture has been properly spread, initial compaction shall be obtained by the use of power rollers weighing not less than 240 pounds per inch width of tread. The surface shall then be finally compacted with rollers weighing not less than 285 pounds per inch width of tread.

The number of rollers engaged in rolling the surface shall not be less than one roller weighing at least 285 pounds per inch of wheel width, for each 300 tons spread in one day of eight hours working time.

A plate shall be attached to each tandem roller which shall list the ballasted and unballasted weight per inch width of tread.

Each roller shall be in charge of a competent, experienced roller operator and shall be kept in as nearly continuous operation as practicable while the work is under way. The pavement shall be rolled longitudinally, diagonally and transversely, as directed. Longitudinally rolling shall start at the side and proceed toward the center of the pavement, overlapping on successive trips by at least one half the width of the rear wheel of the roller. Diagonal rolling shall be in two directions, the second diagonal rolling crossing the lines of the first.

If the width of the work permits, it shall in addition be rolled at right angles to the center line. This method of rolling shall be continued and so executed that all roller marks, ridges, porous spots and impressions are eliminated, and the resulting surface has the required grade and contour. To prevent adhesion of the mixture to the roller, the wheels shall be kept properly moistened but excess water will not be permitted. The use of oil for this purpose will not be allowed.

Along forms, curbs, headers and similar structures and all places not accessible with a roller, the mixture shall be thoroughly compacted with tampers. Such tampers shall weigh not less than 25 pounds and shall have a tamping face area of not more than 50 square inches. The surface of the mixture after compression shall be smooth and true to the established crown and grade. Any mixture which becomes loose and broken, mixed with dirt, or in any way defective shall be removed and replaced with fresh mixture, which shall be immediately compacted to conform with the surrounding area. Areas of one square foot or more showing an excess of bitumen shall be removed and replaced.

The densities of the completed pavement shall be not less than 92 per cent of the calculated density of a voidless mixture composed of the same materials in like proportion. After final compression, samples will be taken from the completed pavements and when tested by standard laboratory methods shall show compliance with aforesaid density requirement.

JOINTS.— Placing of the mixture shall be as nearly continuous as possible, and the roller shall pass over the unprotected end of the freshly placed mixture only when the placing of the course is to be discontinued for such length of time as would permit the mixture to attain initial stability. In all such cases, including the formation of joints as herein specified, provision shall be made for proper bond with the new surface for the full specified depth of the courses.

Longitudinal and transverse joints shall be made in a careful manner, well bonded and sealed, and true to line and grade. Where and as directed, longitudinal and transverse joints for both top and bottom courses placed under this or previous contracts shall be cut back to expose the full depth of the course, and when the laying of the course is resumed the exposed edge of the joint shall be painted with a thin coat of bitumen (Department Specification RC-2). The fresh mixture shall then be carefully raked against the joint, thoroughly tamped and rolled.

In making joints along any adjoining edge such as curb, gutter or an adjoining pavement, and after the mixture is placed by the mechanical spreader, just enough of the hot material shall be placed by hand method to fill any space left open. These joints shall be properly "set-up" with the back of a rake at the proper height and level to receive the maximum compaction. The work of "setting-up" this joint shall be performed always by competent workmen who are capable of making a correct, clean and neat joint.

Where and as directed, the first width of base course shall be placed not less than one foot wider than the first width of top course, and successive widths of top and base courses shall be so placed that there will be at least a one-foot overlap between the joints in the top course and base course.

The rolling of the successive widths of base course and top course shall overlap and shall be so performed as to leave a smooth and uniform joint and cross-section.

When it is necessary to make a transverse joint, the mechanical spreader shall complete the spreading of the material at hand and the course shall be adjusted to a straight line normal to the center line of the pavement, slightly "set-up" with the back of a rake. A plank of the same thickness as the depth of course shall be placed along this line, and the joint rolled at the slowest possible roller speed.

TESTING SURFACE.— When tested with a 16-foot straight edge placed parallel with the center line of the surface course, there shall be no deviation from a true surface in excess of $\frac{1}{4}$ inch. A 10-foot straight edge may be used on a vertical curve.

FINISHED SURFACE.— If, at any time before the acceptance of the work, any soft or imperfect places or spots shall develop in the surface, all such places shall be removed and replaced with new material and then rolled until the edges at which the new work connects with the old become invisible. All such removal and replacement of unsatisfactory surfacing shall be done by the Contractor without additional compensation.

OPENING TO TRAFFIC. No teaming or travel of any kind shall be allowed to pass over the new surface until the pavement has had time to set. Twelve hours will be considered sufficient time for the pavement to set in most cases but this period may be extended by the Engineer as required by climatic or other conditions.

MEASUREMENT AND PAYMENT

The tonnage to be paid for under these Items shall be the number of tons of bituminous concrete and sheet asphalt pavement meeting the specifications, complete in place and approved.

The tonnage determined, as provided above will be paid for at the respective contract unit prices per ton under the Items for Bituminous Concrete Base, Bituminous Concrete Wearing Surface and Sheet Asphalt Wearing Surface, which prices shall be full compensation for furnishing, hauling and placing all materials including necessary forms and equipment, tools and all other incidental work necessary for final completion of the Items as specified, and shall be subject to the following restrictions.

The Contractor will be paid for all materials furnished up to a maximum of the specified depths plus the following tolerances computed separately for each street in the contract.

Bituminous Concrete Base	12%
Bituminous Concrete Wearing Surface	12%
Sheet Asphalt Wearing Surface	10%

If the wearing surface, that is placed on new base of specified thickness, exceeds the tolerance, and the base course is below the tolerance, the amount of wearing surface exceeding the tolerance may be paid as base up to the allowable tolerance of the base.

Excavation for sidewalk and driveway foundation, unless stated otherwise in the proposal will be paid for under Item A2-1, or if rock, under Item A2-3.

PAYMENT ITEMS

C2-1 — Bituminous Concrete Base	Tons
C2-2 — Bituminous Concrete Wearing Surface	Tons
C2-3 — Bituminous Concrete Base for Sidewalks and Driveways	Tons
C2-4 — Bituminous Concrete Wearing Surface for Sidewalks and Driveways	Tons
C2-5 — Sheet Asphalt Wearing Surface	Tons

C2-6 — BITUMINOUS MACADAM PAVEMENT

BASE COURSE

Upon the gravel foundation, prepared as heretofore specified, shall be laid a base course of broken stone, which, after rolling, shall be at least four (4) inches thick.

The broken stone for the base course shall consist of clean, durable crushed rock having a French coefficient of wear of not less than ten (10) and a toughness of not less than eight (8), and shall consist of No. 1, or No. 1 and No. 2 stone. Where both No. 1 and No. 2 stone are used, not more than forty (40) per cent shall be No. 2 stone, at any place.

The No. 1 stone shall consist of stone that will pass through a ring two and one-half ($2\frac{1}{2}$) inches in diameter but will not pass through a ring one and one-quarter ($1\frac{1}{4}$) inches in diameter.

The No. 2 stone shall consist of stone that will pass through a ring one and one-quarter ($1\frac{1}{4}$) inches in diameter but will not pass through a ring three-quarters ($\frac{3}{4}$) of an inch in diameter.

The screenings shall consist of the finer particles of crushed rock, all of which shall pass through a ring not more than three-quarters ($\frac{3}{4}$) of an inch in diameter and which shall be graded from coarse to fine.

The base course shall be shaped to a true section conforming to the proposed cross section of the roadway, and thoroughly rolled.

Any depressions or irregularities which may occur shall be filled with broken stone, and again rolled until the surface is true and unyielding. This course shall then be thoroughly bound with screenings and after being thoroughly rolled, the screenings shall be just below the top of the broken stone and no screenings shall be left on top of the stones.

The rolling shall be done by a power road roller of approved pattern, weighing not less than twelve (12) tons.

When completed the surface of the base course shall be two (2) inches below and parallel to the finished surface of the roadway.

BITUMINOUS MACADAM SURFACE COURSE

Upon the base course prepared as hereinbefore specified shall be laid the bituminous macadam surface, composed of broken stone and bituminous material applied by the penetration method with the bituminous material covered with pea stone.

The broken stone for the surface course shall consist of clean crushed rock having a French coefficient of wear of not less than fourteen (14) and a toughness of not less than twelve (12). The stone shall be thoroughly screened, uniformly graded in size and quality, angular and free from rounded surfaces, and no flat, elongated or otherwise objectionable stone shall be used.

The stone used shall consist of No. 1 stone, excepting that pea stone shall be used for covering the bituminous material.

Pea stone shall consist of that portion of the crushed product which will pass a three-quarter ($\frac{3}{4}$) inch screen and will be retained on a one-quarter ($\frac{1}{4}$) inch screen, and it shall be free from dust.

The bituminous material shall consist of oil asphalt which shall be homogeneous, free from water, and shall not foam when heated to 175 degrees Centigrade (347 degrees Fahrenheit), fulfilling the following requirements:

1. Specific gravity 25°/25° C. (77°/77° F.) not less than 1,000.
 2. Flash point = not less than 175° C. (347° F.)
 3. Melting point = 37° C. (99° F.) to 57° C. (135° F.)
 4. Penetration at 25° C. (77° F.), 100 g., 5 sec. = 85 to 100.
 5. Loss at 163° C. (325° F.), 5 hours not more than 1%.
 - a. Penetration of residue at 25° C. (77° F.), 100 g., 5 sec. not less than 55.
 6. Total bitumen (soluble in carbon disulphide) not less than 99.5%.
- Organic matter insoluble not more than 0.2 per cent.

Upon the broken stone base course shall be spread a surfacing of No. 1 stone, which after rolling shall be at least two (2) inches thick.

The course shall be shaped to a true section conforming to the proposed cross section of the roadway.

Any depressions or irregularities which may occur shall be filled with broken stone, and again rolled until the surface is true and unyielding.

Before any bituminous material is applied, all foreign substances and any unsuitable broken stone or broken stone which has become coated or mixed with dirt or foreign substance, shall be removed and replaced with clean No. 1 stone.

The stone shall be perfectly dry before any bituminous material is applied.

The bituminous material shall be uniformly applied upon the upper course of stone, prepared as above, by an approved pressure distributor at the rate of two (2) gallons per square yard. The surface shall then be covered with sufficient clean pea stone to keep the bituminous material from sticking to the wheels of the roller, care being taken that the rolling starts while the surface is still warm. The pea stone shall be added in small amounts while the rolling continues.

Brooms shall be used in distributing the pea stone, and only a quantity sufficient for filling the voids shall be spread, and any excess shall be avoided.

Immediately before the seal coat is applied, the surface shall be thoroughly swept to remove all loose materials and dust. The seal coat shall then be evenly applied in the same manner as the penetration coat and at the rate of one-half ($\frac{1}{2}$) gallon per square yard and immediately covered with pea stone.

Bituminous material when applied to the upper course shall have a temperature of not less than 300 degrees Fahrenheit nor more than 350 degrees Fahrenheit for asphalt. The Contractor shall not allow the material to be overheated or burnt.

Any depressions or irregularities appearing after the final rolling shall be neatly patched in such a manner as shall be directed by the Commissioner, so that the final surface will be perfectly uniform and true to the specified cross section and grade.

No bituminous work shall be done during rainy weather nor when weather conditions as to temperature or otherwise, are, in the opinion of the Commissioner, unsatisfactory for obtaining good results.

See Subsection C2-7 for MEASUREMENT AND PAYMENT.

C2-7 — BITUMINOUS MACADAM BASE.

Upon the properly prepared subgrade shall be laid a base course of broken stone which, after rolling, shall be at least four (4) inches thick.

The crushed stone shall have a percentage of wear as determined by the Los Angeles Abrasion Test (A.A.S.H.O. Standard Method T-96-38) of not more than thirty-five (35) per cent and shall consist of the following:

(1) Clean, durable, crushed rock consisting of the angular fragments obtained by breaking and crushing solid or shattered natural rock. It shall be graded uniformly in accordance with the following requirements:

SQUARE OPENING SIEVES

SIZE OF SIEVE	PER CENT BY WEIGHT PASSING THROUGH					
	COMBINATION		No. 1 STONE		No. 2 STONE	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
2½ Inches	100		100			
2¼ Inches	95	100	95	100		
2 Inches			70	95		
1¾ Inches					100	
1½ Inches			20	50	95	100
1¼ Inches	0	50	0	15		
1 Inch			0	5		
¾ Inch	0	15			0	25
½ Inch	0	5			0	5

This grading is based on the requirements that the crushed rock shall be either No. 1 Stone or such a mixture of No. 1 Stone and No. 2 Stone as will contain no more than forty per cent (40%) of No. 2 Stone.

Pea stone shall consist of that portion of the crushed product which will pass a three-quarters ($\frac{3}{4}$) inch screen and will be retained on a one-quarter ($\frac{1}{4}$) inch screen, and it shall be free from dust.

The bituminous materials of this type shall be produced by the careful steam and/or vacuum distillation of an asphaltic base petroleum at a temperature at which no decomposition or cracking takes place. They must be free from tar or tar products. Only those asphalts which have proven satisfactory in service tests will be accepted. They shall be homogeneous, free from water, shall not foam when heated to 175 degrees Centigrade (347 degrees Fahrenheit) and shall meet the following requirements:

OA-3. This specification provides for a material suitable for use in construction of bituminous macadam from May 15 to September 14, inclusive.

OA-4. This specification provides for a material suitable for use in the construction of bituminous macadam from September 15 to May 14, inclusive.

	OA-3 Minimum	OA-3 Maximum	OA-4 Minimum	OA-4 Maximum
Specific Gravity, 25°/25° C. (77°/77° F.) . . .	1.00	—	1.00	—
Flash Point, degrees F.	347	—	347	—
Penetration, 25° C. (77° F.) 100 gm. 5 sec. . . .	85	100	100	120
Loss on evaporation, 163° C. (325° F.), 5 hrs. .	—	1.0	—	1.0
Penetration of residue from evaporation, per cent of original penetration, 100 gm. 6 sec. 25° C. (77° F.)	60	—	60	—
Ductility, centimeters 25° C. (77° F.)	60	—	60	—
Total Bitumen (Soluble in CS ₂)	99.5	—	99.5	—

The penetration macadam base shall be shaped to a true section conforming to the proposed cross section of the roadway and two and one-half ($2\frac{1}{2}$) inches for bituminous concrete and three (3) inches for sheet asphalt below and parallel to the finished surface of the roadway. The rolling shall be done by a road roller of approved pattern weighing not less than twelve (12) tons. Any depression or irregularity which may occur shall be filled with broken stone and again rolled until the surface is true and unyielding.

The stone shall be perfectly dried before any bituminous material is applied. The bituminous material shall be uniformly applied upon the base course of stone, prepared as above by an approved pressure distributor, at the rate of two (2) gallons per square yard. The surface shall then be covered with sufficient clean pea stone to keep the bituminous material from sticking to the wheels of the roller, care being taken that the rolling starts while the surface is still warm.

Brooms shall be used in distributing the pea stone and only a quantity sufficient for filling the voids shall be spread and any excess shall be avoided. Bituminous material when applied shall have a temperature of not less than three hundred (300) degrees Fahrenheit nor more than three hundred and fifty (350) degrees Fahrenheit for asphalt. The material shall not be allowed to be overheated or burnt.

Any depression or irregularity appearing after the final rolling shall be neatly patched in such a manner as shall be directed by the Commissioner of Public Works. No bituminous work shall be done during rainy weather, nor when weather conditions as to temperature or otherwise, are, in the opinion of the Commissioner of Public Works, unsatisfactory for obtaining good results.

MEASUREMENT AND PAYMENT

The quantity of crushed stone shall be determined from tickets delivered with each load. These tickets are to be signed by a certified sworn weigher and countersigned by a City Inspector.

Macadam Pavement or Macadam Base will be paid for at the contract unit price per ton of crushed stone which price shall include full compensation for furnishing, placing, filling and rolling of all material (including key stone) and all labor, tools, equipment and incidental expenses necessary to complete the work.

Bituminous material will be paid for at the contract unit price per gallon of OA asphalt applied, complete in place, and this price shall include full compensation for furnishing, hauling, heating and applying the bituminous material and all incidental expenses necessary to complete the work.

PAYMENT ITEMS

C2-6 — Crushed Stone for Macadam Pavement.....	Tons
C2-7 — Crushed Stone for Macadam Base.....	Tons
C2-8 — OA Asphalt.....	Gallons

GUARANTY FOR ALL PAVEMENTS

NOTE.—The word pavement used hereunder refers to both sidewalk and roadway pavement.

(a.) In consideration of the sum of one dollar (\$1) cash in hand paid, the receipt whereof is hereby acknowledged, and the price herein stipulated to be paid and received for the construction of said pavement, the Contractor hereby binds and obligates himself and does hereby agree to use such material and so construct said pavement that it will be and remain in good repair and condition for and during a period of five years from the completion and acceptance of the pavement, so that at the end of said period said pavement shall be in good serviceable condition and free from any defect that will impair its usefulness, it being understood and agreed that all repairs which may at any time become necessary on account of the failure to use such material and so construct said pavement shall be performed faithfully and promptly at all times when required by the City.

(b.) The City shall have the right to open the pavement for its own purpose and to grant permission to corporations, companies or individuals to open it.

(c.) Whenever the City opens or grants permission to open, it shall forthwith notify the Contractor, when the trench is fit to repave such opening, except when the City takes test cores of this new contract work, in which case the hole caused by coring will be filled in by City Forces.

(d.) The Contractor shall, within fifteen (15) days of the date of such notice, repave such opening with the kind of pavement herein specified. The Contractor shall be paid for this work by the City Department, Public Service Corporation or any other permittee who made the opening in the street. Payment is to be made on the basis of rates established by the Commissioner of Public Works in accordance with the provisions of Section 9 of Chapter 27 of the Revised Ordinances of 1947. In the default of the Contractor to make such repairs either in full or in part, the Contractor shall be in no wise relieved of his obligations because of such repair made by the City.

(e.) In case parties, who have made openings in pavements and the subsoil, have not properly retamped the trench, the Contractor, before repairing the pavement, shall redig and retamp the trench and receive therefor the cost of labor plus fifteen (15) per cent.

(f.) The Contractor shall, at his own expense, just before expiration of the guaranty, make such repairs as may be necessary to make the pavement comply with the following conditions:

1. It shall have a contour substantially conforming to that of the pavement as first laid and free from depressions of any kind exceeding one-half ($\frac{1}{2}$) inch in depth as measured between any two points, three (3) feet apart, on a line conforming substantially to the original contour of the pavement.

2. It shall contain no disintegrated wearing surface mixture and shall be free from all signs of disintegration.

3. It shall not have been reduced in thickness more than three-quarters ($\frac{3}{4}$) of an inch in any part.

4. Its foundation shall be free from defects that will cause disintegration or settling of the pavement or impair its usefulness.

5. If any spalling, splitting, scaling, roughness of surface, settlement, cracking or other defect caused by poor materials, faulty construction, settlement of foundation or subgrades, or not protecting the work, occurs in any division or block of artificial stone within the guaranty period, such division or block shall be immediately replaced with a new division or block conforming to these specifications, upon notification from the Commissioner.

(g.) Except as otherwise specified, all repairs to the wearing surface shall be made by cutting the defective pavement down to the foundation and replacing it by a new and freshly prepared pavement complying with the specifications for the original pavement.

(h.) The surface heater method of making repairs is to be used only for repairing defects due to neither of the following named causes:

1. Failure of the concrete base.
2. Disintegration of the lower portion of the wearing surface.

(i.) Defect due to failure of the foundation shall be repaired by taking up the defective pavement for its entire depth, including foundation, and replacing it with new pavement complying with the specifications for the original pavement.

(j.) In using the surface heater method all defective surfacing shall be removed before any of it is replaced with new material. The old surfacing shall be removed to a depth of at least one-quarter ($\frac{1}{4}$) of an inch and the new surfacing when compressed shall be at least one (1) inch thick. The heat shall be applied so as not to injure the remaining pavement. Burnt and loose material shall be promptly and completely removed, and while the pavement is still warm replaced with the new surfacing made and laid in accordance with these specifications.

D1-1 — DRY WELLS

Furnish all labor and materials and construct dry wells, three (3) feet in diameter and four (4) feet deep, below the subgrade of the sidewalk.

The wells are to be filled, to within one (1) foot of the top, with coarse broken stone, and the remainder with number two (2) broken stone.

MEASUREMENT AND PAYMENT

Dry wells will be measured by the individual number of dry wells constructed as specified, and will be paid for at the contract unit price for each dry well, complete in place. This price shall include all labor, excavation and materials necessary to construct the dry well in accordance with the specifications.

PAYMENT ITEM

D1-1 — Dry Wells. Each

D1-2 — GROUND WATER DRAINS

Furnish and lay ground water drains, where directed, as shown on plan numbered Oc-471. The unit price bid under this Item shall include all labor and material necessary to furnish and install the drain and its connections, including excavation, preparing site, crushed stone back fill, joint wrapping, drain tile and connecting catch-basin pipe.

MEASUREMENT AND PAYMENT

Ground Water Drain will be the actual length of drain laid, measured in lineal feet, and will be paid for at the contract unit price per lineal foot, including excavation, back fill, and all labor, material and equipment necessary to complete work.

PAYMENT ITEM

D1-2 — Ground Water Drain.....Lineal Feet

D1-3 — RESETTING EXISTING INSTALLATIONS

All existing water boxes, sewer manholes, Bradley Heads, catch basin frames and other castings under the jurisdiction of the City shall be adjusted to change in line or grade or change in kind of casting as shown on plan or as directed. All castings shall be set on brick masonry where necessary to conform to the line and grade required. Any alterations involving five or less courses of new brick will be considered as intended under this Item; more than five courses will be paid for under Item D1-6. After casting has been set to grade on new masonry it must be encased in concrete at least from subgrade to within 2½ inches from top of casting, or for at least to a depth of six inches and for a distance of 18 inches around the outside of casting. The cost of the concrete and brickwork shall be included in the price bid for this item. All pavement and base removed and excavation where necessary shall be included in price bid for this item.

Unless the Contractor is ordered so to do in writing in any specific case and at terms fixed in this contract, the City is to reset and repair other covers and structures to be left in the street, and the Contractor is not to interfere with or hinder this work or to injure any thereof.

In the event that new castings which are under the jurisdiction of the City are needed, the City will supply said castings.

PAYMENT ITEM

D1-3 — Existing Installation Reset.....Each

D1-4, 5 AND 6 — CATCH BASINS AND DROP INLETS BUILT, AND CATCH BASINS REMODELED

Catch Basins and Drop Inlets shall be constructed to the lines and grades as shown on the plans and as directed, all in accordance with the Standard Specifications of the Sewer Division.

Iron work and guttermouths will be furnished by the City at the Sewer Yard but shall be hauled from said yard to the work site by the Contractor, and the cost for such hauling shall be included in the respective prices bid under Items D1-4 and D1-5.

Where directed, catch basins and manholes shall be remodeled or substantially rebuilt, and the price for this work shall include excavation, removing part of existing structure and its contents, rebuilding with brick masonry to proper shape, back fill and all incidental work.

MEASUREMENT AND PAYMENT

Drop Inlets and Catch Basins of any type will be measured by the actual count of the number of Catch Basins and Drop Inlets built.

Drop Inlets and Catch Basins of any type, built, will be paid for under their respective contract unit prices, including all excavation (except rock excavation), materials, labor and equipment to construct complete in place, where directed, according to the standard specifications of the City of Boston Sewer Division. Rock excavation will be paid for under Item A2-3.

PAYMENT ITEMS

D1-4 — Catch Basin.....Each
D1-5 — Drop Inlet.....Each
D1-6 — Catch Basins Remodeled.....Each

E1-1 — PARKING METERS RESET

Where directed, all parking meters are to be reset to required line and grade. For normal sidewalks (without areaways below) a hole for the 2½-inch O.D. post shall be excavated fourteen (14) inches below the finished grade of the sidewalk; three inches of concrete shall then be deposited in the bottom of the excavation, the post set thereon in a truly vertical position, 18 inches back of the

face of the edgestone; the post hole shall then be filled with Class B concrete to within four inches of the finished grade of the sidewalk.

Where areaways below sidewalk, or other reasons, prevent the above type of installation, the parking meters shall have a special flange with 4-inch anchor bolts, 4 to a flange. Where resetting of this type is necessary they shall be carefully broken out without damage to flange or anchor bolts and reset to new line and grade. All posts shall be set to a uniform height above the finished grade of the sidewalk.

MEASUREMENT AND PAYMENT

Parking Meters Reset will be measured by the actual count, complete in place, and will be paid for at the contract unit price each, including all labor, material and equipment necessary to complete the work.

PAYMENT ITEM

E1-1 — Parking Meters Reset. Each

E1-2 — SIGN POSTS

Iron sign posts 12 feet six inches in length and three and one-half inches internal diameter will be furnished by the City at the Paving Yard, and hauled and set or reset by the Contractor. A hole for the post shall be excavated 18 inches in diameter and three feet six inches below the finished grade of the sidewalk and three inches of concrete shall then be deposited in the bottom of the excavation, the post set thereon in a truly vertical position, 15 inches back of the face of the curb. The post hole shall then be filled with Class B concrete to within four inches of the finished grade of the sidewalk.

MEASUREMENT AND PAYMENT

Sign Posts will be measured by the actual count of the number of sign posts set or reset.

Sign Posts hauled from the City Yard and set, or existing sign posts reset, will be paid for at the contract unit price each, including hauling, excavation, backfill, concrete and all labor and equipment to complete the work in place.

PAYMENT ITEM

E1-2 — Sign Posts Set or Reset. Each

E1-3 — STONE BOUNDS

Stone bounds shall be of sound granite, free from cracks and defects, and placed where directed by the Commissioner of Public Works.

The top and bottom faces shall be parallel and the front and back sides shall be straight split.

The top of the bound shall be six (6) inches square and dressed and shall be free from all drill holes or other marks. The four (4) sides are to be dressed to a depth of not less than eight (8) inches from the top. The depth of the bound shall be four (4) feet.

CONSTRUCTION METHODS

The bound shall be set to the depth and position as directed and the top shall be flush with the finished surface of the work.

Excavation shall be made three (3) feet square on the surface and four (4) feet deep. The backfill shall be clean gravel thoroughly compacted by tamping.

MEASUREMENT AND PAYMENT

Stone bounds will be measured by the actual number of stone bounds set.

Stone bounds will be paid for under the contract unit price each, including excavation (except rock excavation), backfill, labor, material and equipment, complete in place. Rock excavation will be paid for under Item A2-3.

PAYMENT ITEM

E1-3 — Stone Bounds. Each

PART V

STANDARD SPECIFICATIONS

OF

BRIDGE DIVISION

GENERAL PROVISIONS

Including the General Provisions set forth hereinbefore under the Standard Specifications of the Highway Division, and without limiting the generality thereof, the following General Provisions are added at this Part V of the Standard Specifications of the Public Works Department as being conditions more specifically pertinent to Bridge Division Work.

(a.) The Contractor shall prepare whatever detail drawings are needed to carry out the work and shall submit them to the Commissioner for his approval before beginning work under the same. There shall be no changes made on such plans after approval except with written consent of the Commissioner.

Copies of all shop drawings and shop lists made for the work shall be filed with the Commissioner for reference, before shipment of the work. The Contractor shall furnish as many additional copies and prints as are needed for the supervision of the work and for record.

At completion of the work, the Contractor shall furnish the City with one complete, corrected set of all plans (in ink, on tracing cloth) made by him.

Where piece marks are shown on the plans, the same shall be clearly marked on all the corresponding pieces and members of the work.

(b.) The Contractor shall be required to adjust his operations so that there will be no interference whatsoever with railroad traffic or with waterborne traffic, and no unreasonable delay in the progress of the work.

Whenever a railroad company requires the use of flagging services in connection with the work, the Contractor shall make all arrangements with the railroad company as required, and shall pay the railroad company direct for such services, at no extra expense to the City.

Clearances equal to or greater than the present clearances above and beside the tracks of the railroad shall be maintained at all times, except as may be otherwise permitted by the railroad company.

Particular attention is directed to the Special Provisions relative to the order and manner of doing the work and to the maintenance of vehicular and pedestrian traffic facilities during the work under contract.

(c.) The Contractor shall maintain the deck carrying traffic in constant repair by refastening loose roadway materials and patching wherever and whenever required, so that continuous safe passage for all vehicles and pedestrians will be insured; and the cost of such work shall be considered incidental work under the contract and shall incur no extra expense to the City.

(d.) The Contractor shall furnish, erect and maintain (all at no additional expense to the City) temporary barriers on the roadways and sidewalks as may be required to completely barricade the area in which the work is being done. Such temporary barriers shall be constructed as required and approved by the Commissioner.

Work will not be allowed to commence under this contract until the Contractor has complied with all requirements relating to traffic barriers, and flashing red electric lights, to the complete satisfaction of the Commissioner.

(e.) Before commencing work under this contract the Contractor will be required to submit to the Commissioner for his approval, written notice of the Contractor's proposed manner and sequence of operations and shall not begin work without said approval, in writing, but such approval shall in no way relieve the Contractor of his responsibility for the proper maintenance and protection of the work.

(f.) Particular attention is directed to the requirement that the Contractor must make every effort to prevent the occurrence of fire, and shall provide and maintain adequate fire extinguishing equipment at the site of the work. In addition, he shall obtain and pay for burning permits and fire-watch services, if required.

(g.) The Contractor shall assume full responsibility for accurately locating underground or submarine cables, pipes, and similar facilities that might be encountered in carrying on the work; and for protecting the same from injury.

(h.) No materials are to be thrown overboard or allowed to go adrift in the channelways. Any materials that may accidentally fall overboard (or on to the railroad property) shall be retrieved immediately by the Contractor at his own expense.

SECTION F-1

BRIDGE EXCAVATION, GRADING AND FILLING

GENERAL

F1-1 — BRIDGE EXCAVATION.

Bridge Excavation shall include the removal and satisfactory disposal of masonry and all other materials (except rock) that are encountered in the construction, reconstruction and repair of abutments, wing walls and piers of bridges. Bridge excavation shall also include the removal and satisfactory disposal of all materials in existing substructures as shown on the plans or where directed.

All other excavation encountered in the construction, reconstruction or repair of bridges, not otherwise defined in these specifications, will be classed and paid for under Item A2-1.

If it is intended that sections of an existing structure are to be retained, the Contractor shall take special care so that such parts or sections of the existing structure are not disturbed or damaged during the excavation operation.

The Contractor shall protect all property along or adjacent to the work as provided in these Specifications.

F1-2 — CHANNEL EXCAVATION.

Channel Excavation shall include the removal and satisfactory disposal of all materials encountered in the under-water excavation and dredging operations for channels, streams or rivers.

It will not include material classed herein as Bridge Excavation or Rock Excavation.

CONSTRUCTION METHODS

The Contractor shall so prosecute his work that traffic will be maintained over and through the work with a maximum of safety and convenience.

The sequence of all excavation operations shall be such as to insure the most efficient utilization of excavated materials if such material is found to be suitable for the work.

All suitable materials obtained from the excavation, from the removal of present structures, or wherever available within the reasonable limits of the work shall be used for backfill under, over, or around structures, pipe culverts or drains and at such other places within the limits of the work as directed and the material shall be placed, rolled, and tamped in a manner conforming to the specification for the particular type of work required, without additional compensation.

If the excavated material is not needed or not suitable it shall be disposed of as directed outside of the location in such a manner as not to obstruct streams or otherwise impair the drainage, appearance, safety, or efficiency of any structure or any other part of the work, without additional compensation.

Excavated material shall not be placed adjacent to the location without the approval of the Commissioner and all slopes shall be left with neat even surfaces, according to the lines, grades, and directions given.

All backfilling shall be made with suitable materials uniformly distributed and tamped or puddled. When suitable backfilling material cannot be obtained from excavation, the filling shall consist of satisfactory bank gravel.

Backfilling shall not be placed on or against masonry, or other structures until permitted. It shall be formed of successive layers not more than six (6) inches in depth, uniformly distributed, each layer being thoroughly compacted before the succeeding layer is placed.

The backfill immediately back of abutments, wing walls and retaining walls shall be made with clean gravel. The gravel shall be composed of hard, durable stone and coarse sand practically free from loam and clay and shall contain no stones measuring over three (3) inches in their longest dimension. Slag, if specified to be used, shall consist of clean, satisfactory fused or partly fused compounds of silica in combination with lime or other bases resulting in secondary products from the reduction of metallic ores. These materials will be included in the Item for gravel borrow. This backfill may be compacted by puddling methods as directed.

Wherever backfill is placed in back of (or over) arches or rigid frames, extreme care shall be used to bring the backfill up evenly on each side so that unequal pressure will be avoided. The Contractor shall prosecute the work of backfilling with such additional requirements as to sequence of operations as the Commissioner may direct.

Cofferdams shall be constructed by the Contractor for the foundation work as specified or indicated on the plans and whenever the nature of the work requires them. Before starting this work the Contractor shall submit for comment by the Commissioner sketches and details of the cofferdam construction he proposes to use, but such comment shall not relieve the Contractor from full responsibility for their safety and construction.

Each cofferdam shall be sufficiently tight to prevent the flow of water through the area in which the work is to be done, and shall be built to adequate strength to withstand all pressures to which it may be subjected. The top of the cofferdam shall be sufficiently above the water to prevent flooding the interior by any reasonable rise in elevation of the water during the use of the cofferdam. The bottom of the cofferdam shall be a sufficient depth below the proposed foundation grade to permit a reasonable change (at least 2 feet) in depth of the foundation within the cofferdam, if directed.

Pumping, bracing and other work within the cofferdam shall be done in a manner to avoid disturbing the construction. As work progresses, the cofferdam shall be rebraced, if necessary, in such a manner that no bracing shall extend permanently through or into concrete or other construction within the cofferdam.

After sufficient progress on the construction within the cofferdam has been made, all materials and equipment used for the cofferdam shall be removed.

Channel areas to be dredged or excavated shall be made as level and smooth as possible over their entire extent, at or below the plane of the proposed bottoms.

The accuracy of borings and depths shown on the plans are not guaranteed to be correct and no responsibility for depths of water or character of the material is assumed by the City.

All piles, sunken logs, timbers, wrecks and other obstructions which may be encountered within the areas to be dredged shall be removed by the Contractor.

Banks shall be sloped at such an angle as will maintain the required depths, but no flatter than three (3) feet horizontal to one (1) foot vertical. All existing ridges and shoals, and those made by the Contractor in doing the work shall be removed by him to the satisfaction of the Commissioner.

Any material which may slide down into the excavated area during or as a result of the work shall be removed by the Contractor.

Ranges, stakes, tide gauges, flags, buoys and anchors, rope, and other materials needed for the proper supervision, measurements, laying out and inspection of the work, shall be furnished and maintained in good order by the Contractor.

The Contractor shall take all necessary precautions, by shoring or otherwise, to protect all walls or other structures not to be removed under this contract and shall repair any damage caused by the dredging operation.

Trench excavation and related pipe laying shall conform respectively to the complete Standard Specifications of the Sewer and Water Divisions unless specifically excepted on plans, Special Provisions, Amendments or Addenda covering a particular project.

Rock excavation shall conform to, and will be measured and paid for in accordance with Item A2-3, as outlined under Part IV, Standard Specifications of the Highway Division.

MEASUREMENT AND PAYMENT

All classes of Excavation will be measured in their original position by the cross-section method except that where this method is impracticable the volume shall be measured by such other methods as the Commissioner may determine. In calculating excavation for structures the sides of the excavation will be considered vertical.

Bridge excavation shall be measured to the neat lines of proposed abutments, wing walls, and piers as shown on the plans and from the original surface of the ground to the bottom of the required excavation unless otherwise noted on the plans or specified in the Special Provisions.

Excavation made outside the lines prescribed for payment will be considered as made for the Contractor's convenience. Such excavation will not be included for payment under any Item of excavation and the refilling of such excavated areas will not be included for payment under any Item of filling material.

Channel excavation will be measured for payment by accredited agents of the City, by soundings taken before and after the excavation, or by actual scow measurements of excavated material. Either or both methods of measurement may be used at the option of the Commissioner depending upon local conditions and expediency.

Excavation for structures will be paid for at the contract unit price per cubic yard for the particular type of excavation encountered.

The unit price per cubic yard shall include all backfilling, when the materials are obtained from excavation, all clearing and grubbing (except as may be otherwise provided in the Special Provisions), all excavations for the structure, formation of embankments, disposal of surplus material, and the furnishing of all equipment, tools, labor, and work incidental thereto.

If cofferdams, sheeting, shoring or other methods of control for excavations are not specifically Items in the contract, no allowance in addition to the prices bid for any Items in the contract will be made for such control or controls, or for labor, equipment or materials for such controls. If any change in depth of foundation or in other dimensions of the foundation is provided, and if such change is greater than can be accommodated by the controls as constructed by the Contractor with the approval of the Commissioner, then any changes made as directed by the Commissioner will be paid for in accordance with the contract provisions for Extra Work. Excavation, borrow, concrete, or other Items of work done within the controlled area will be paid for only at the contract prices for these Items unless the operations require different or additional equipment or labor in addition to or different from that required for the original design of control. If such different or additional equipment or labor is required to perform the operation for the pay unit of an Item, the additional costs will be paid for as Extra Work. Where salvage of material is involved in the additional work, the value of the salvage shall be deducted from the additional payments.

Backfilling when not obtained from excavation will be paid for at the contract unit price for the kind of material used.

The unit price paid per cubic yard for any of these Items shall be full compensation for furnishing all labor, materials, and equipment necessary to complete the work in a satisfactory manner.

Bridge excavation will be paid for at the contract unit price per cubic yard of Bridge Excavation. All other excavation encountered in the construction of bridges, not otherwise defined in these specifications, will be classed and paid for under Item A 2-1.

Channel excavation (except rock) and all under water excavation for riprap will be paid for at the contract unit price per cubic yard of Channel Excavation.

PAYMENT ITEMS

F1-1 — Bridge Excavation.....	Cubic Yards
F1-2 — Channel Excavation.....	Cubic Yards

SECTION F-2

SHEETING

GENERAL

This work shall consist of furnishing and placing lumber or steel sheeting of the kinds and dimensions required, complying with these specifications, where indicated on the plans or where directed.

MATERIALS

Lumber sheeting shall be sound spruce, Douglas fir or yellow pine plank not less than 4 inches thick, planed on one side and either tongued and grooved, or splined. The thickness of the sheeting shall be increased if so ordered by the Commissioner.

Steel sheeting shall be of approved section and quality, either new or secondhand, weighing not less than 22 pounds per square foot of wall.

CONSTRUCTION METHODS

Work shall not be started until all materials and equipment necessary for construction are either on the site of the work or satisfactorily available for immediate use as required. Sufficient labor and equipment shall be employed to insure the completion of the excavation, placing of the concrete and backfilling in the shortest possible time. The schedule of lengths of sheeting shall be approved by the Commissioner before any work is started.

The sheeting shall be securely and satisfactorily braced to withstand all pressures to which it may be subjected and shall be sufficiently tight to prevent any flow of water or material into the space in which concrete is deposited. Where no other direction is given, sheeting shall be driven to such depth that the footing may be lowered at least two feet below the elevation shown on the plans without any change in the sheeting as driven. Jetting may be done only with approval of the Commissioner, but it will not be permitted when excess of water may endanger railroad tracks or other structures.

When, in the opinion of the Commissioner, the foundations must be altered to such an extent that changes must be made in the depths to which sheeting has been driven, or the area enclosed by the sheeting must be changed, the Contractor shall make the directed changes in accordance with the provisions for Extra Work and payment for the additional cost to the Contractor for such changes will be made as provided in the Contract Articles covering Extra Work.

The sheeting shall be driven down or cut off to the elevation shown on the plans or directed by the Commissioner. No sheeting may be left so as to create a possible hazard to navigation of a waterway, safety of the public, obstruction to flow of water, or a hindrance to traffic of any kind.

All cut-off will become the property of the Contractor and shall be removed by him from the site.

Cut-off shall not be allowed to float away in a stream or left in such a manner as to obstruct the flow of water.

The responsibility for the exact satisfactory construction and maintenance of sheeting complete in place shall rest with the Contractor and any work done which in the performance of incidental construction is not acceptable for the intended purpose shall be either repaired or removed and reconstructed by the Contractor at his expense.

MEASUREMENT AND PAYMENT

Lumber sheeting left in place as a permanent part of the foundation will be measured by the thousand feet board measure of lumber sheeting. The quantity to be paid for will be the product of the area of the sheeting in place by the nominal thickness.

Steel sheeting left in place as a permanent part of the foundation will be measured by the pound. The weight of the quantity to be paid for shall be calculated on the basis of sheeting 22 pounds per square foot of wall in place. No additional compensation will be allowed if a heavier sheeting is used unless such heavier sheeting is specified in the Special Provisions.

Lumber sheeting cut-off will be measured in the same manner as lumber sheeting. Steel sheeting cut-off will be measured in the same manner as steel sheeting. In both cases, the length of cut-off will be the difference between the length of sheeting approved by the Commissioner and the length of sheeting left in place, but will not include any lengths cut off for correction of damaged ends.

Steel sheeting when indicated on the plans to be left in place or when ordered left in place as a permanent part of the foundation will be paid for at the contract unit price per pound under the item for Steel Sheeting, which price shall include all materials, driving, re-driving, bracing, shoring, cutting, burning and any other work necessary for exact completion of the Item.

Lumber sheeting when indicated on the plans to be left in place or when ordered left in place as a permanent part of the foundation will be paid for at the contract unit price per thousand feet board measure for Lumber Sheeting, which price shall include all materials, driving, re-driving, bracing, shoring, cutting and any incidental work necessary for the exact completion of the Item.

No direct payment will be made for any sheeting not indicated on the plans or not ordered in writing by the Commissioner to be left in place as a permanent part of the foundation. Such sheeting will be considered as incidental work necessary for the proper prosecution and protection of the work during construction operations and compensation therefor shall be included in the prices bid for the various Items of work for which the sheeting was used. If the Contractor elects to leave such sheeting in place with the approval of the Commissioner, no payment will be made for same as sheeting left in place.

For purposes of partial payment the sheeting Item will be considered 90 per cent done when the sheeting has been completely driven and the area within the sheeting is ready for such work as may be required to be done therein. The sheeting Item will be considered completed when the sheeting has been cut at the required elevation or removed as the case may be.

Payment of cut-off allowance on sheeting required to be left in place as a permanent part of the foundation will be made at the unit rate specified in the Special Provisions.

Payment will not be made for cut-off of sheeting not indicated on the plans or not ordered by the Commissioner to be left in place, and payment will not be made for any waste or for sheeting abandoned with the prior approval of the Commissioner.

PAYMENT ITEMS

F2-1 — Lumber Sheeting.....	M.F.B.M.
F2-2 — Steel Sheeting.....	Pounds

SECTION F-3

PILES

F3-1 AND 2 — TIMBER PILES

GENERAL

This work shall consist of the furnishing, driving, and cutting off of timber piles in conformity with these specifications. The piles shall be driven at designated locations in the manner and to the penetration and bearing capacity shown on the plans or as directed by the Commissioner.

PILE SCHEDULE.— The Contractor shall submit to the Commissioner for comment a schedule of the lengths of piles he proposes to order, and the schedule shall designate the respective locations of the piles. The scheduled length shall comprise the length expected to be left in the structure plus the length that might be necessary to provide fresh heading.

If piles furnished according to the approved schedule of length prove inadequate to sustain the required load, the Engineer may in writing make changes in the schedule previously approved by him and the piles ordered and driven according to the revised schedule will be paid for at the contract unit price per lineal foot.

If as a result of the revised schedule any of the piles which have been purchased by the Contractor in accordance with the approved schedule cannot be used elsewhere on the project, such piles not used will be paid for under the provisions of Extra Work, except that no profit or overhead will be allowed, and subject to an allowance for the fair salvage value of the piles.

MATERIALS

TIMBER PILES

A. GENERAL REQUIREMENTS.— Each pile shall be sound and straight. It shall be free from any defects that will impair its strength or usefulness for the purpose intended or that will prevent proper driving. It shall be the responsibility of the Contractor to obtain satisfactory piles of the particular species required by the Special Provisions. Material that splits under driving or proves otherwise unsatisfactory shall be removed from the site at the sole expense of the Contractor.

All piles shall be cut above the ground swell, shall have a uniform taper from butt to tip end, and shall be free from short kinks. Knots or blemishes shall be trimmed off close and even with the body of the pile. A line from the center of the butt to the center of the tip must lie wholly within the body of the pile.

B. INSPECTION.— All piles will be subject to inspection before or after shipment to the site, or both, at the option of the Commissioner. Any pile that does not conform to all the requirements will be rejected.

C. SPECIFIC REQUIREMENTS.— The kind of timber to be used for treated piles will depend upon the particular preservative treatment, as follows: When creosote treatment to a retention of 16 pounds or more per cubic foot of wood is specified, the piles may be of Southern Yellow Pine, Douglas Fir (coast region), or Red Oak, subject to the selection and approval of the Commissioner. All piles for which treatment is specified shall have not less than 1 inch of sapwood at the butt end.

Untreated piles shall be new spruce, oak, Douglas fir, yellow pine, or any other species, subject to the selection and approval of the Commissioner, and which will withstand the specified driving without injury.

Butt and tip dimensions for various lengths of piles shall be as set forth in the following table:

Length	Minimum Dimension 3 Feet from Butt	Minimum Tip Dimension
Up to 40 ft.	12 inches	8 inches
40 ft. and up to 50 ft.	12 inches	7 inches
50 ft. and over	13 inches	6 inches

For all piles, the maximum dimension three feet from the butt shall be 18 to 20 inches in diameter. Measurements are under the bark in all cases. Where the piles are to support a concrete cap, the maximum butt dimension shall be six inches less than the designated width of the concrete cap.

Where piles are to be in line in a bent, all piles in the bent shall be of uniform size to permit the proper fastening of the bracing. Cutting of piles to accommodate the bracing will not be permitted.

PRESERVATIVE TREATMENT.—When preservative treatment is specified, piles shall be treated with Grade 1 creosote oil in conformance with the current specifications of the American Wood Preservers' Association. Unless otherwise specified in the Special Provisions, the retention of creosote oil shall be as follows:

Surrounding Material	Pounds of Creosote Oil per Cubic Foot of Wood
Earth	12
Fresh Water	16
Salt Water	20

For treatment to a retention of 12 pounds, the full cell process or the empty cell process may be used. For greater retention than 12 pounds, only the full cell process shall be used. The Contractor shall notify the Commissioner of the name and location of the treating plant as soon as he has placed the order for the piles. If the Commissioner does not arrange for inspection, the Contractor will be required to furnish to the Department, for approval, five copies of a certificate from the treating plant stating that the methods of treatment conform to the requirements specified, and five copies of a certificate giving the chemical analysis of the preservative. These certificates shall be furnished before any piles are driven. Furnishing of the certificates by the Contractor shall not act as a bar to rejection of any piles if the Commissioner subsequently finds that the piles do not meet the requirements. Any cost involved in furnishing the certificates shall be borne by the Contractor.

SATURATED FABRIC.—The fabric for use in waterproofing the heads of treated piles that are not to be capped shall conform to the requirements of A.S.T.M. Designation D-173.

CONSTRUCTION METHODS

PREPARATION FOR DRIVING.—When piles are located in an area where excavation is to be made or in an area where borrow is to be placed, the piles shall not be driven until the excavation has been made or the borrow has been placed. For either of the foregoing, the grade shall be brought to such an elevation as to compensate for possible uplift of the surrounding earth or for its subsidence. Adjustments in the grade shall be made after all the piles at the location have been driven. Additional excavation or borrow will be considered as part of the process of pile driving and will not be included in the payment for either excavation or borrow.

Piles shall have their butt ends bound with steel collars or bands to protect them in the driving operation, or the pile driving equipment shall include a pile-capping and cushion block assembly to prevent brooming and splitting; whichever method may prove most effective, consistent with best modern practice. The piles shall be pointed by tapering the tip to no less than four inches square. If required, metal shoes of a design satisfactory to the Commissioner shall be provided, in which case the points of the piles shall be carefully shaped to secure a uniform bearing on the shoes.

The shoes shall be made of 1/16-inch steel plate, pyramid shape, conical tip of same diameter as the end of the pile, with straps to fasten the shoe to the pile with a 1/2-inch bolt in such a manner that the force of the hammer blow will not force the bolt into the pile. The inside of the shoe shall be smooth in order to permit full bearing throughout between the pile and the shoe. The design of the shoe shall be prepared by the Contractor and shall be submitted to the Commissioner for approval. Shoes not approved by the Commissioner will not be paid for and shall not be used.

DRIVING PILES.—The driving of piles with followers shall be avoided if possible. The use of followers shall be only with the written permission of the Commissioner.

Treated piles shall be handled carefully so as not to bruise or break the outer surface or penetrate it with tools.

The first pile driven for a group of piles shall be the one nearest the center of the group. Where underground utilities are located in the immediate vicinity, the first pile driven shall be the one nearest the utility.

All piles shall be driven vertically or battered as directed, and shall be accurately spaced and in true alignment.

Fixed leads shall be used during the driving of all piles and the leads shall be adjustable for batter. As an alternate to fixed leads, adequate grids may be constructed in a manner to maintain the pile in the position and alignment indicated on the plans.

Piles shall be driven by a steam hammer or air hammer, or by a combination of water jet and hammer. The hammer shall be an approved type, single-acting or double-acting, developing the specified energy per blow, but in no case less than 7,000 foot-pounds actual energy per blow. The hammer shall be in good condition and shall be capable of delivering the maximum blows per minute required by the manufacturer's specifications. Scaleboards, graduated in feet and inches, shall be attached to the leads of the pile driver. A drop hammer will not be permitted.

If jetting is permitted, it shall be done with twin jets, and the jets shall at all times be above the tip of the pile. The volume and pressure of the water at the jet nozzle shall be sufficient to freely erode the material adjacent to the pile. The plant shall have a sufficient capacity to deliver at all times at least 200 pounds per square inch pressure at the jet nozzle. A water relief valve set at the required pressure and a gauge shall be part of the equipment. Before the desired penetration is reached, the jet shall be withdrawn and the pile shall be driven with the hammer to secure the final penetration in a stratum not previously affected by the jet.

Each pile shall be driven continuously from the start of driving until the required penetration and bearing capacity are attained. Intermittent driving will not be permitted unless specifically authorized in writing by the Commissioner.

DETERMINATION OF BEARING VALUES

A. **LOADING TEST.**—When directed by the Commissioner, the bearing power of a pile shall be determined by an actual loading test.

The work consists of furnishing all materials and all labor, equipment, and tools in connection with the work of making the test as specified. The pile to be tested shall be at the location of the proposed foundations, driven as specified for the foundation piles, and intended as a pile to remain as part of the structure. Each pile to be tested shall be driven to the design pile load, based on the appropriate formula set forth herein, unless otherwise directed in writing by the Commissioner.

1. **Loading Equipment.**—A loading platform or box shall be centered over the pile to be tested. The weight capacity of this platform or box shall be not less than twice the load to which the foundation piles are to be driven. The method of transferring the load to the pile will be the option of the Contractor, provided the method is adaptable to accurate measuring of the load and the method avoids eccentric loading on the pile. The pile shall be adequately braced to avoid action as a column instead of as a pile. Before starting the work the Contractor shall submit to the Commissioner for approval a written description of the equipment and method the Contractor intends to use. The methods shall be altered as necessary to meet the approval of the Commissioner. Only an approved method shall be used.

2. **Loading Sequence.**—For a steel, timber, or precast concrete pile, no load shall be placed on the pile for at least 48 hours after the pile has been driven. For a cast-in-place concrete pile, no load shall be placed on the pile for at least seven days after the concrete has been placed in the shell, and the exposed concrete at the top of the pile shall be fully protected from the elements until the loading test has been completed. For all but steel piles, the loads shall be applied in increments of five tons, each succeeding loading remaining constant for not less than 30 minutes, and until settlement ceases. The loading shall be continued by increments of five tons and at the time interval of at least 30 minutes until a total load equal to the design load has been applied. The design load shall remain constant for

12 hours and until no further settlement occurs. The loading shall then be continued in increments of five tons until a total load of twice the design load has been applied, or the pile has failed. The final load shall be held on the pile for at least 24 hours after all settlement has ceased. For steel piles the increments shall be 10 tons.

3. *Unloading Sequence.*—The unloading shall be in decrements of 10 tons. Each successive load shall remain constant for not less than 30 minutes and until rebound has stopped.

4. *Settlement Readings.*—Under each loading increment, settlement readings shall be recorded one minute, two minutes, five minutes, fifteen minutes, and thirty minutes after application of a load. When it is necessary that the load shall be held constant for longer than thirty minutes in accordance with the provisions under Loading Sequence, additional readings shall be made at intervals of 30 minutes.

5. *Measuring Devices.*—The Department will furnish the engineers levels and the men necessary to make observations. All measuring devices and gauges that may be necessary, other than levels, shall be furnished by the Contractor.

B. BEARING POWER FORMULAS.—In the absence of loading tests the safe bearing values for piles shall be determined by the following formulas:

$$P = \frac{2 WH}{S + 1.0} \quad \text{for gravity hammers}$$

$$P = \frac{2 WH}{S + 0.1} \quad \text{for single-acting steam or air hammers}$$

$$P = \frac{2 H(W + Ap)}{S + 0.1} \quad \text{for double-acting steam or air hammers}$$

where

P = safe bearing power in pounds

W = weight in pounds of striking part of the hammer

H = height of fall in feet

A = area of piston in square inches

P = steam or air pressure in pounds per square inch at the hammer

S = the average penetration in inches per blow for the last five to ten blows for gravity hammer, or the last ten to twenty blows for steam or air hammers.

Twice the height of the bounce shall be deducted from the height of the fall to obtain the "H" used in the formula.

The above formulas are applicable only when:

- (a) the hammer has a free fall;
- (b) the head of the pile is not broomed or crushed;
- (c) the penetration is reasonably quick and uniform;
- (d) there is no sensible bounce after the blow;
- (e) a follower is not used;
- (f) the hammer is operated within the range established by the manufacturer.

The bearing power as determined by the foregoing formulas shall be considered applicable only when it is less than the crushing strength of the pile. Each pile shall be required to develop a bearing power of not less than 13 tons if no other capacity is stated.

Gravity hammers shall not be used unless specifically permitted in writing by the Commissioner.

The above formulas will be modified by the Commissioner if he deems it necessary on the basis of information obtained from a loading test.

TEST PILES.—When required, the Contractor shall drive test piles of the length and at the location designated by the Commissioner. These piles shall be driven with the same equipment that the Contractor proposes to use in driving for the proposed structure.

REPLACEMENT, CUTTING-OFF AND SPECIAL TREATMENTS.— Any pile which may be driven in the wrong position shall be withdrawn and redriven in the correct position. Any pile which may prove too short after driving, or which may be split or broomed in the driving, shall be withdrawn and another and satisfactory pile shall be substituted and properly driven.

The tops of piles shall be sawed-off to a true plane at the grades shown on the plans or otherwise fitted as required. For treated piles that are to be doweled into concrete, the dowel holes shall be bored after the pile has been cut off, and these holes shall be filled with hot creosote. The tops of these piles shall be given two applications of hot creosote, the second application to be made after the first has been fully absorbed. The heads of treated piles that are to be capped with wood shall be treated with two applications of a mixture of 60 per cent creosote oil and 40 per cent pitch. The heads of treated piles that are not to be capped shall be covered with four applications of pitch and three layers of saturated woven cotton fabric, applied alternately. The fabric cover shall measure at least six inches more in diameter than the pile, and shall be fastened to the pile with large-headed galvanized nails; or the fabric shall be bound to the pile with seven complete turns of galvanized wire securely held in place by staples and large-headed galvanized nails.

At all other cuts and abrasions on creosoted piles, the piles shall be neatly trimmed and treated with two applications of a mixture of 60 per cent creosote oil and 40 per cent pitch. Bolt holes shall be treated by means of an approved pressure bolt hole treater. Any holes that would otherwise remain unfilled shall be treated and then plugged with creosoted plugs. Nail holes shall be filled by driving galvanized nails flush with the surface of the pile.

MEASUREMENT AND PAYMENT

Timber piles will be measured by the lineal foot, and the quantity to be paid for shall be the actual number of feet of piling conforming to these specifications and remaining in the finished structure.

Pile cut-offs will be measured by the lineal foot and the length to be paid for will be the difference between the length of piles approved by the Commissioner on the schedule submitted by the Contractor and the length of piles in place, but will not include any lengths cut off for correction of damaged ends or for piles rejected by the Commissioner.

If lengths of piling cut off are of sufficient length to be used as piles on the project, and if they are so used with the permission of the Commissioner or at his direction, such lengths of piling driven and left in place will be considered as piles. There shall be no duplication of measurement for cut-off and pile.

Untreated timber piles will be paid for at the contract unit price per lineal foot under the Item for Untreated Timber Piles, left in place, when the piles are untreated; or under the Item for Treated Timber Piles, left in place, when the creosote treatment is used. In either case, the contract price shall constitute full compensation for furnishing all material, equipment, labor and incidentals required to complete the work in accordance with these specifications. This price shall also include full compensation for metal shoes if shoes are specified in the Special Provisions for the particular project. If the use of shoes is directed by the Commissioner subsequent to opening of bids, the Contractor shall provide the shoes in accordance with the provisions of the Articles for Extra Work and payment for the shoes will be made as provided therein.

Payment of cut-off allowance on treated or untreated timber piles will be made at the rate per lineal foot specified in the Special Provisions.

Test piles, if used in the structure, will be paid for at the contract unit price per lineal foot, as in the case of other piles. If the test pile is not used in the structure, it will be paid for at the contract unit price each under the Item for Test Piles, and this price shall also include full compensation for the removal of the test pile.

Pile loading will be paid for at the contract unit price for each pile tested under the Item for Pile Loading Tests. The contract price shall include full compensation for all labor charges; for all materials, equipment, and tools; for all loss of materials; and for all other costs incurred and necessary for the

proper execution of the test. The contract price shall also include full compensation for any interruptions to pile driving or other operations in the vicinity of the pile loading tests. The test at each pile shall be considered completed when all materials and equipment used in the test have been removed. All records obtained during the test shall be the property of the Department. Furnishing and driving the piles complete in place will be paid for under the Item for the type of piles for which the test is made. If cut-offs are an Item to be paid for, the cut-off will be paid for at the allowance specified in the Special Provisions. If the pile load test is applied to a cast-in-place concrete pile, then the contract price for that Item shall also include full compensation for cutting the pile to the grade necessary to properly incorporate the pile in the structure or, if it is not to be incorporated in the structure, for cutting the pile to the grade necessary to avoid its interference with the proposed construction.

If a pile should fail during a test, it will nevertheless be paid for by the lineal foot in place at the time the pile was under test.

PAYMENT ITEMS

F3-1 — Untreated Timber Piles.....	Lineal Feet
F3-2 — Treated Timber Piles.....	Lineal Feet
F3-3 — Test Piles.....	Each
F3-4 — Pile Loading Tests.....	Each
Allowance for Untreated Timber Pile Cut-off.....	Lineal Feet
Allowance for Treated Timber Pile Cut-off.....	Lineal Feet

F 3-5 — CAST-IN-PLACE CONCRETE PILES

GENERAL

Cast-in-place concrete piles shall consist of steel shells driven to the specified penetration and resistance and then filled with cement concrete as indicated on the plans. Cast-in-place concrete piles shall be placed in the manner, at the locations, and to the elevations shown on the plans or directed by the Commissioner. Steel shells shall be left in place.

MATERIALS

STEEL SHELLS.— Shells shall conform to the requirements of the Special Provisions, and shall be of a type and design approved by the Commissioner; but only one type shall be used for the contract. The tip shall be steel, firmly fastened to the bottom section.

Shells must be of sufficient thickness and strength so that each shell will hold its original form and show no harmful distortion during driving and after it and adjacent shells have been driven, and to furnish the proper lengths required to satisfy the minimum penetration and the final driving resistance. All shell connections shall be bonded to each other in a manner to prevent displacement during driving.

The minimum tip diameter shall be eight inches. The minimum butt diameter shall be 12 inches when the specified loading is 30 tons or less, or shall be 14 inches when the specified loading is over 30 tons but not more than 40 tons.

It is required that the butt of each pile as driven and filled with concrete shall have an area of steel of not less than $1\frac{1}{2}$ per cent of the total area of the minimum required butt, and that such area of steel shall be continuous for one third the length of the pile (but not less than 10 feet) measured down from the line of cut-off. If the steel shell at the upper portion of the pile is more than 0.12 of an inch thick, the thickness of the shell reduced one sixteenth of an inch from the outer surface shall be considered part of the required area of steel. If the shell for the prescribed length is not at least 0.12 of an inch thick, then no part of the shell shall be considered as part of the required area of steel. If the shell does not provide the required area of steel as prescribed in this paragraph, then the pile shall be brought to the required steel area by placing symmetrically four hooked steel bars in the pile. These bars shall extend into the pile for one third the length of the pile (but not less than 10 feet) and shall protrude 18 inches from the pile butt to the top of the hook in the footing. When any such bar reinforce-

ment is required, the minimum size shall be No. 6 bars. No. 3 hoops, two feet on centers, shall be firmly secured to the bar reinforcement. Where the pile shell provides the required area, four No. 6 bars shall be placed symmetrically in the pile top, extending five feet into the pile and protruding 18 inches from the pile butt to the top of the hook in the footing.

CEMENT CONCRETE. — The cement concrete shall be Class D with air entrainment, conforming to the applicable requirements of Section C-1.

STEEL REINFORCEMENT. — Steel reinforcement shall conform to the requirements of Section F-6, except that full compensation for the specified reinforcement and hoops shall be included in the payment for the pile.

CONSTRUCTION METHODS

DRIVING SHELLS. — All excavation at the proposed location of the piles shall be made before the piles are driven. The excavation shall be made to such an elevation as to compensate for possible uplift or subsidence of the surrounding earth. If the uplift has been underestimated, any further required excavation shall be made after all piles at the location have been driven. If the excavation has been made to an excessive depth, gravel borrow shall be used as fill and the borrow shall be thoroughly compacted to the proposed bottom of the foundation. Such fill or further excavation shall be considered as part of the process of pile driving and will not be included in the payment for either excavation or borrow.

A steel mandrel may be used in the driving of piles. The pile driving equipment shall be such as will ensure driving in the locations indicated on the plans. The pile driver shall be of the rigid frame type with leads forming an integral part of the driver. The hammer shall be approved type, steam or air operated. The hammer shall be in good condition and shall be capable of delivering the maximum blows per minute indicated by the manufacturer's published specifications. Where no other hammer is specified, the hammer shall be one that will develop the specified energy per blow, but in no case less than 15,000 foot-pounds. If satisfactory driving is not accomplished with the hammer selected, a different type and size of hammer shall be used. Scaleboards, graduated in feet and inches, shall be attached to the leads of the pile driver.

When permitted, the shells may be driven with a combination of water jet and hammer. When a water jet is used for preliminary penetration, the final penetration shall be made with the hammer alone into a stratum not previously affected by the jet.

The first shell driven for each footing shall be the one nearest the center of the group, and successive driving shall be from the center outward to the edge of the footing. If any driven shell is raised by the subsequent driving of adjacent shells, it shall be re-driven to the required penetration and resistance, with no compensation for the additional driving. If, in the opinion of the Commissioner, the conditions during driving indicate that resistance is due to an obstruction, the Contractor shall employ adequate methods to drive through the obstruction or shall remove the obstruction.

Each shell shall be driven continuously from the start of driving until the required penetration and bearing capacity are attained, except for any interruptions while adding new sections of pile.

If test piles are specified or directed, then no pile other than the test piles shall be driven until the results of the test loads have been analyzed.

BEARING VALUES. — The piles shall be driven to a safe bearing value of 30 tons unless otherwise specified. The bearing value shall be determined by a loading test or bearing power formula.

A. LOADING TEST. — When required, the bearing value of concrete piles shall be determined by actual loading tests as specified in Section F-3.

B. BEARING POWER FORMULAS. — In the absence of loading tests the safe bearing values shall be determined by the use of the bearing power formulas for timber piles, except that for piles driven with a mandrel, the denominator in the formulas shall be changed to $S + 0.1 \frac{W}{w}$ where w = the weight, in pounds, of the driven mass, including the shell, the mandrel, and the driving head.

The pile formula will be modified by the Commissioner, if he deems it necessary, on the basis of information obtained from a loading test or on the basis of observations made during the driving.

INSPECTION OF SHELLS. — After the shells have been driven they shall be inspected and approved before the concrete is placed. At all times prior to the placing of concrete in the driven shells, the Contractor shall have available a suitable light for the inspection of each shell throughout its entire length. Shells which have been improperly driven, do not hold the form and dimensions as approved, or are broken, distorted or otherwise defective, shall be removed or corrected to the satisfaction of the Commissioner.

PLACING REINFORCEMENT. — Reinforcement shall be placed in the manner shown on the plans or as directed.

PLACING CONCRETE. — After the piles are in place they shall be cut off at the proper grade and care shall be taken not to injure the pile below the cut-off.

Concrete shall not be placed in a shell until all shells within a radius of 15 feet have been satisfactorily driven. All concrete shall be vibrated for a depth of 20 feet down from the top of the completed shell. If conditions during construction warrant, the Commissioner may, at his discretion, order that any or all shells shall be driven before any shell is filled with concrete.

The concrete shall be placed continuously in each shell, care being used to fill every part of the shell. Should the shell contain water which, in the opinion of the Commissioner, might injure the concrete, methods approved by him shall be provided to correct this condition before placing concrete.

PROTECTION. — During cold weather the pile heads and surrounding ground shall be covered by straw or other suitable protection to prevent frost from damaging the concrete itself or heaving the ground.

During hot weather the pile heads shall be protected by suitable covering material.

PAINTING. — Unless otherwise provided, when pile shells extend above the ground surface or water surface, they shall be protected by three coats of paint as specified under Structural Steel. This protection shall extend from an elevation two (2) feet below the water or ground surface to the top of the exposed steel.

MEASUREMENT AND PAYMENT

Cast-in-place concrete piles will be measured by the lineal foot and the quantity to be paid for shall be the actual number of lineal feet of pile built into the structure as measured from the point of pile to cut-off grade.

Cast-in-place concrete piles will be paid for at the contract unit price per lineal foot under the Item for Cast-in-Place Concrete Piles complete in place. This price shall constitute full compensation for all materials (including shells, cement concrete, painting and reinforcement), equipment, bracing, driving, cutting off or building up of shells, removal and disposal of water or foreign matter from shells, protection of pile heads and other incidental work required to complete the work in accordance with these specifications.

Loading tests will be paid for at the contract unit price under the Item for Pile Loading Tests.

PAYMENT ITEM

F3-5 — Cast-in-Place Concrete Piles Lineal Feet

STEEL PILES

F 3-6

GENERAL

This Item shall consist of the furnishing, driving, splicing and cutting off of steel piles in conformity with these specifications. The piles shall be driven at designated locations in the manner and to the penetration and bearing capacity shown on the plans or as directed by the Commissioner.

PILE SCHEDULE.—Within two weeks after the execution of the contract, the Contractor shall submit a proposed schedule of lengths to the Commissioner for approval. Approval by the Commis-

sioner shall not relieve the Contractor of his responsibility to furnish piles of proper lengths. The scheduled length for each location shall comprise the length assumed to remain in the structure, plus the length that might be necessary to provide fresh heading.

MATERIALS

STEEL PILES.—Steel piles shall consist of structural steel shapes of the section given on the plans. The steel shall conform to the requirements of A.S.T.M. Designation A-7. Copper bearing steel will not be required.

Preferably, the piles shall be furnished in a single piece of the required length. Where the approved proposed length of pile is greater than 60 feet, the Contractor will have the option of furnishing the pile in a single piece or of furnishing each pile in two pieces, approximately equal in length, to make up the required length. In the latter case, the pile shall be spliced, as indicated on the plan, but this splice will not be included as a unit for payment under the item for Steel Pile Splices.

CONSTRUCTION METHODS

STORAGE AND HANDLING.—Special care shall be used in the storage and handling of piles to avoid injury to them. When the piles are placed in the leads the camber or sweep shall not be greater than allowed by the standard mill tolerances.

PREPARATION FOR DRIVING.—Excavation at each location shall be made to such an elevation as to compensate for possible uplift or subsidence of the surrounding earth. If the uplift has been underestimated, any further required excavation shall be made after all the piles at the location have been driven. If the excavation has been made to an excessive depth, gravel borrow shall be used as fill and the borrow shall be thoroughly compacted. Such fill or further excavation will be considered as part of the process of pile driving and will not be included in the payment for either excavation or borrow.

DRIVING AND SPLICING PILES.—Pile driving equipment shall be such as will assure driving in the locations and to the batter indicated on the plans. The pile driver shall be of the rigid frame type with leads forming an integral part of the driver. The hammer shall be an approved type, steam or air operated, single-acting or double-acting, developing the specified energy per blow, but in no case less than 15,000 foot-pounds actual energy per blow. The hammer shall be in good condition and capable of delivering the maximum blows per minute indicated by the manufacturer's specifications. Scaleboards, graduated in feet and inches, shall be attached to the leads of the pile driver.

Where no definite lineal penetration is directed, the piles shall be driven to bed rock or to practical refusal. Unless otherwise specified or determined after a load test practical refusal will be considered attained when the penetration does not exceed three inches in 30 successive blows of the hammer when the weight of the ram of the hammer is approximately equal to the weight of the entire length of pile.

The use of water jets will be permitted only when excess of water will not affect adjacent structures. In general, jetting will not be permitted near railroad tracks. When driving to bed rock, at least the last two feet of penetration shall be made without the jet. When driving to practical refusal, as defined above, that resistance must be obtained in a stratum not previously affected by the jet.

Each pile shall be driven continuously from the start of driving until the required penetration and bearing capacity are attained. Intermittent driving will not be permitted unless specifically authorized in writing by the Commissioner. If conditions during driving indicate that the pile is hitting an obstruction, the Contractor shall drive through the obstruction or shall use whatever means are necessary to remove the obstruction.

Care shall be taken not to injure the pile in driving. A satisfactory protective steel hood shall be placed between the hammer and top of the pile. Should the top of the pile be damaged so as to interfere, in the opinion of the Commissioner, with the satisfactory driving of the pile, the driving shall be discontinued, the pile shall be burned off perpendicular to its axis, and the driving shall then be resumed. Any pile which is damaged in driving (other than at the top) shall be withdrawn and another

pile shall be substituted; or, if permitted by the Commissioner, the damaged pile may be spliced at some point such that the completed pile will be satisfactory. Splicing for this purpose will not be included as a unit of payment under steel pile splices. Where the scheduled length of pile proves insufficient to reach bed rock or practical refusal, the pile shall be spliced and driving shall then be continued. Splices made for this reason will be paid for under the Item for Steel Pile Splices. The additional length of pile ordered spliced to the scheduled length will be considered an approved addition to the schedule.

In all cases, splices shall be made as indicated on the plans. If the type of splice is not indicated on the plans it shall be plate splices combined with butt-welding. Plate splices shall consist of three diamond plates, one on each flange and one on the web. The butt-welding shall be designed to develop the full strength of the pile, both in bearing and in bending. Welding shall conform to the current specifications for Welded Highway and Railway Bridges of the American Welding Society.

Piles pushed up by the driving of adjacent piles shall be redriven at no additional expense to the City.

PILE CUT-OFFS.—After the driving has been completed the piles shall be cut at the directed grade. If pile caps are indicated, they shall then be welded in place. Cutting of piles shall not be done until it is certain that further operations will have no effect on the previously driven piles.

The cut-off shall become the property of the Contractor.

MEASUREMENT AND PAYMENT

Steel piles will be measured by the lineal foot and the quantity to be paid for will be the actual number of feet of piling left in place in the finished structure.

Where piles are spliced because the scheduled length proved insufficient, each pile splice will be considered as one unit to be paid for under the Item for Steel Pile Splices. Where damaged piles are spliced with the permission of the Commissioner, such splicing will not be included as a unit for payment as a splice.

Steel pile cut-offs will be measured by the lineal foot and the length of cut-off to be paid for shall be the difference between the total of lengths of piling approved on the schedule, including any additional lengths ordered spliced to the scheduled lengths, and the total of length left in place, but shall not include the lengths cut off for the process of splicing, or for the correction of damaged ends, or for the correction of piles in driving. Piles or parts of piles rejected by the Commissioner will not be measured for payment as piles or as cut-off.

All steel piles will be paid for at the contract unit price per lineal foot under the Item for Steel Piles, complete in place, which price shall also include full compensation for the pile caps complete in place.

Pile splices, when measured for payment, will be paid for at the contract unit price each under the Item for Steel Pile Splices complete.

Payment of cut-off allowance on steel pile will be made at the rate per lineal foot specified in the Special Provisions for each lineal foot of cut-off remaining after all piles have been driven. If the Contractor uses or is directed to use the cut-offs, spliced or unspliced, as piles or parts of piles for any part of the work, such piling and splices will be paid for under the Items of Steel Piles and Steel Pile Splices, and will not be included in the measure of cut-offs.

The above contract unit price shall also include full compensation for delays incurred by splicing of piles or by any other operations in connection with the work on piles

PAYMENT ITEMS

F3-6 — Steel Piles	Lineal Feet
F3-7 — Steel Pile Splices	Each
Allowance for Steel Pile Cut-off	Lineal Feet

SECTION F-4

CEMENT CONCRETE MASONRY

GENERAL

Cement concrete masonry for bridges, walls, or other structures shall be constructed to the dimensions and design indicated on the plans and to the lines and grades established by the Commissioner, with or without reinforcement as required.

Where necessary, at the direction of the Commissioner, the dimensions or design may be adjusted to fit foundation, slope or construction conditions as encountered.

MATERIALS

CONCRETE. — The class of concrete for each structure or portion of structure shall be as designated on the plans or as called for in the Special Provisions. If the limits or classes of concrete are not definitely defined on the plans, the Commissioner shall designate the class and limits to be used.

The concrete shall conform to all the applicable requirements of Section C-1 for the class of concrete specified.

Where finishing of the concrete is to be done by hammering or any other method that breaks the surface of the concrete, only crushed rock shall be used for coarse aggregate.

CEMENT. — Unless otherwise specified in the special provisions for a particular project, all cement shall be American Portland cement of a brand satisfactory to the Commissioner, and conforming to the "Standard Specifications for Portland Cement," A.S.T.M. Designation: C-150, and only one type of cement shall be used in a single structure. When an air-entrained concrete is specified to be used, the methods and materials to produce such concrete shall conform to the applicable requirements of Section C-1.

REINFORCING STEEL. — Reinforcement for all cement concrete masonry shall consist of deformed steel bars conforming to Specification A-305 of the A.S.T.M., and shall be of domestic manufacture.

Reinforcing bars shall be rolled either from new billet steel or rail steel. Bars rolled from rail steel will not be accepted for stirrups, hoops, or bridge decking.

New billet steel reinforcing bars shall be intermediate grade, and shall conform to the requirements of Specification A-15 of the A.S.T.M.

Rail steel reinforcing bars shall conform to the requirements of Designation A-16 of the A.S.T.M.

Cold-drawn wire or welded wire fabric for concrete reinforcement shall conform to the requirements of the "Standard Specifications for Cold-Drawn Steel Wire for Concrete Reinforcement" (A.S.T.M. Designation: A82), or "Standard Specifications for Welded Steel Wire Fabric for Concrete Reinforcement" (A.S.T.M. Designation: A185).

If wrought iron bars are required to be used as dowels, these bars shall conform to the requirements of A.S.T.M. Designation A189. All other dowels shall conform to the requirements for steel reinforcing bars as specified above.

All reinforcement shall be free from imperfections and surface coatings of rust, dirt, oils, paint, grease and mill scale; and shall present a clean, fresh surface when placed in the structure. Rust that occurs in scales or that pits the steel will be considered an imperfection. Surface rust will not be considered an imperfection, but the surface shall be brushed to remove loose material.

CONSTRUCTION METHODS

FORMS. — Approved centers and forms shall be provided by the Contractor. Piles shall be used for falsework if required by the Commissioner. No extra compensation for falsework or falsework piling will be allowed, such work being considered a part of the form work. Falsework shall be set to

give the structural camber indicated on the plans or as specified, plus allowance for shrinkage or settlement. Forms, except as hereinafter specified, shall be made of planed lumber, and shall conform to the design of the work.

Forms for all exposed portions of bridges and structures shall be lined with approved material, or form sheathing shall consist of five-ply waterproofed ply wood, approved metal sheathing or other approved material in order to give the concrete a smooth even finish.

Forms shall be in good condition and cleaned and oiled or properly treated to produce an approved finish on the surface.

The sheathing shall be jointed tightly to prevent leakage from the mix and it shall be of sufficient strength to hold the concrete without bulging between supports. Forms shall be properly braced and tied so as to maintain correct dimensions. Bolts and rods shall be used for internal ties. Wire ties will not be permitted except when directed or where concrete is not exposed to view.

The Commissioner may require the Contractor to employ screw jacks or hard wood wedges in connection with the centering of falsework in order to take up any slight settlement in the form work either before or during the placing of concrete. Any metal ties or anchorages which are required within the forms to hold them to accurate alignment and location shall be so designed that the metal can be removed to a depth of at least two (2) inches from the surface of the concrete without injury to such surface by spalling or otherwise. Wire ties shall be cut one-quarter ($\frac{1}{4}$) inch back of the face of the concrete. All cavities produced by the removal of metal ties shall be carefully filled with mortar composed of fine aggregate and cement in the proportions used in the mix.

Prior to placing concrete in the forms, all foreign matter, lumber and wire ends shall be removed.

The centers shall be true to the lines, satisfactorily supported and firmly secured. They shall remain in place as long as directed and shall be replaced by new ones if they lose their proper dimensions or shape.

Forms shall be removed from the concrete not less than seventy-two (72) hours after the concrete is placed, and then only with the permission of the Commissioner; but such permission shall not relieve the Contractor of any liability for damage or accident.

REINFORCEMENT.— The Contractor shall submit for approval detailed plans and schedules of the reinforcement showing dimensions, bending details, and spacing so that the reinforcement may be properly placed and its weight readily computed. The making of these drawings shall not be sublet without the Commissioner's approval. If impracticable to obtain or use bars of the full length required, bars shall be lapped by each other to an extent equal to forty (40) diameters.

The steel shall be bent in the shop true to templates and shall be placed accurately as shown on the plans. The reinforcement shall be placed in an approved manner so as to insure its remaining in the correct position during the placing and hardening of the concrete. Splicing shall not be at points of maximum stress. In no case shall the clear distance between bars be less than one inch, nor less than one and one-third times the maximum size of the coarse aggregate. Where reinforcement in beams or girders is placed in two or more layers, the clear distance between layers shall not be less than one inch, and the bars in the upper layers shall be placed directly above those in the bottom layer.

CONCRETE PROTECTION FOR REINFORCEMENT.— The reinforcement of footings and other principal structural members in which the concrete is deposited against the ground shall have not less than three inches of concrete between it and the ground contact surface. If concrete surfaces after removal of the forms are to be exposed to the weather or be in contact with the ground, the reinforcement shall be protected with not less than two inches of concrete.

The method of holding bars in place must be such as to support the weight of workmen without displacement.

Dowels, where required, shall be furnished and placed as indicated on the plans and as directed.

HANDLING AND PLACING CONCRETE

A. TRANSPORTATION.— The concrete shall be transported from the mixer and placed in the forms by a method which will permit handling concrete of the slump required without segregation.

Buggies and wheelbarrows used for this purpose shall be equipped with pneumatic tires. Chutes shall be metal or metal lined, sloped to a pitch of between one to two and one to three. Long chutes shall be provided with reversed flow or remixing hoppers in order to correct for segregation.

B. DEPOSIT.— The concrete shall be placed in the forms in an approved manner to prevent stone pockets, voids or segregation and to reduce rehandling and flowing in the forms to a minimum. The concrete shall not be dropped more than three (3) feet or flowed or dragged over ten (10) feet in the forms. Points of deposit shall be spaced not more than twenty (20) feet apart nor more than ten (10) feet from the ends of the form. Concrete shall be properly distributed in the forms by hand shoveling. The forms shall be filled in thin horizontal layers, each layer extending completely across the forms. The forms shall be filled at a rate of one (1) to three (3) feet per hour. Care shall be taken to avoid splashing the forms and reinforcing above the level of the concrete as placed. Beams and slabs shall be poured in one continuous operation.

C. CONSOLIDATION.— Each layer shall be thoroughly consolidated by puddling and vibration. The face of the forms shall be carefully spaded to bring a dense mortar to the face, and produce a good finish.

All concrete or masonry structures, unless otherwise directed, shall be compacted by means of an approved mechanical vibrator operated within the mass of the concrete. The Contractor shall provide approved methods of vibration to fully consolidate the mix. Vibrators shall be of the internal type, of standard make and approved capacity, at frequencies of not less than 4,500 impulses per minute.

Vibration of forms or reinforcing shall not be permitted except where internal vibration is not practicable and then only with approval of the Commissioner.

The vibrator shall be applied directly to the mass at the point and time of deposit and moved throughout the mass continuously from point to point in the mix using care to avoid over-vibration, causing segregation, over-finished surface and excess water gain. Vibrators shall not be used close to the forms.

A sufficient number of vibrators shall be provided to obtain proper placing in accordance with the rate of deposit.

Extreme care shall be taken to prevent penetrating or disturbing previously placed concrete which has become partially set.

D. BOULDERS IN MASS CONCRETE.— When and where permitted by the Commissioner, boulders may be incorporated into mass concrete and shall consist of sound stones of a size and shape to conform to the requirements of construction.

The boulders shall be thoroughly cleaned and wet. On any rammed layer of concrete, boulders shall be bedded not less than six (6) inches from each other, from the forms and from reinforcement, and all spaces between boulders, forms and reinforcing steel shall be filled with thoroughly rammed concrete.

E. PLACING CONCRETE UNDER WATER.— Concrete shall not be deposited in water except with the written approval of the Commissioner and under his immediate supervision.

The concrete shall be of the Class required except that an additional ten per cent of cement shall be added to all concrete deposited under water. The coarse aggregate shall be gravel.

The method and equipment to be used shall be approved by the Commissioner before work is begun. The method used shall be one which will prevent the washing of the cement from the mixture, will avoid the flow of water until the concrete is fully hardened, and which will minimize the formation of laitance and segregation of materials.

Care shall be exercised to avoid disturbance of the concrete during depositing or thereafter. The concrete shall be distributed uniformly over the entire area between the forms in order to maintain a level surface.

The work shall be carried out in a continuous operation and with sufficient rapidity to prevent the formation of layers or inclined seams. Concrete shall not be placed in water having a temperature below 30 degrees Fahrenheit. Pumping will not be permitted while concrete is being deposited, nor before it has fully hardened.

One of the following methods may be used:

1. *Bottom Dump Bucket*.—The bucket shall be open top type and have a capacity of not less than one cubic yard and shall also be of a type that cannot be dumped until it rests on the surface on which the concrete is to be deposited. The bottom doors, when tripped, shall open freely downward and outward. The bucket shall be withdrawn slowly until well above the level of the water.

2. *Tremie*.—The tremie shall be water tight, consisting of a tube constructed in sections with flange couplings fitted with gaskets, and the inside diameter shall be sufficiently large to permit a free flow of concrete. The tremie shall be supported so as to permit free movement of the discharge end over the entire surface of the work and to permit rapid lowering when necessary to retard or stop the flow of concrete. The discharge end shall be closed at the start of the work to prevent water from entering the tube and shall be kept entirely sealed at all times and the tremie tube kept full to the bottom of the hopper during the depositing of the concrete. The concrete shall be discharged and spread by raising the tremie in such a manner as to maintain as nearly as practicable a uniform flow and to avoid dropping the concrete through the water. The flow shall be continuous until the work is completed. If the charge is lost during depositing, the tremie shall be withdrawn and refilled.

Unwatering may proceed when the concrete seal is sufficiently hard and strong. All laitance and scale shall be removed so that sound, durable concrete is exposed.

JOINTS.

A. *CONSTRUCTION JOINTS*.—Concrete in structures shall be placed in such a manner that all construction joints shall be exactly horizontal or vertical, as the case may be, and that they shall be straight and as inconspicuous as possible.

When construction joints are definitely shown on the plans, all concrete between consecutive joints shall be placed in a continuous operation.

In order to allow for shrinkage, concrete shall not be placed against the second side of the construction joints for at least 12 hours after that on the first side has been placed.

Approval of the Commissioner in writing must be secured before the placing of any construction joints not shown on the plans.

The planes on which a day's work is to terminate shall be predetermined before depositing of concrete begins. They shall in general be perpendicular to the lines of principal stress and in regions of small shears. Horizontal joints will not be permitted in concrete girders, beams, abutments, or retaining walls, unless otherwise indicated on the plans. Slabs acting with concrete beams or girders shall be deposited continuously with them, unless otherwise indicated on the plans.

Unless otherwise indicated on the plans, interlocking or keying at construction joints shall be provided by use of blocks, stones, keyways or dowels in a manner approved by the Engineer.

Horizontal joints in piers or abutments shall generally be avoided and when used shall not be located within three feet of the normal water level.

In piers or gravity abutments requiring a construction joint, it shall generally be a keyed vertical joint extending the full height above the footing. In piers, abutments or retaining walls the second portion placed at a vertical joint shall be placed not earlier than 24 hours after the first portion is placed, except with special permission of the Commissioner.

Construction joints, not shown on the plans and above ordinary low water level, in abutments and retaining walls that retain earth fills shall be waterproofed on the back with a premolded sealing strip or equal, at the Contractor's expense.

Joints in cantilevered members, unless shown on the plans, shall be avoided.

When making a horizontal construction joint, care shall be taken to have the concrete below the joint as dry as possible and any excess water or creamy material shall be drawn off before the concrete

sets. Within 12 hours after the concrete below the joint has been placed, the top surface shall be thoroughly cleaned by the use of wire brushes and all laitance and loose material removed so as to expose clean, solid concrete. Care must be taken not to loosen any of the coarse aggregate in the concrete. If for any reason this laitance is not removed before the concrete has hardened in place, it shall be removed using such tools and methods as may be necessary to secure the results specified above. Immediately before placing concrete above the joint, the surface of the concrete below the joint which has been cleaned as specified above shall be thoroughly wetted and flushed with mortar of the same proportions used in the concrete. This mortar shall be thoroughly brushed into all openings and crevices with a stiff broom. On all exposed surfaces, the line of the proposed joint shall be made truly straight by tacking a temporary horizontal straight edge on the inside of the form with its lower edge on the line of the joint and then placing the concrete sufficiently higher than this edge to allow for settlement. Immediately before placing the new concrete, the forms shall be drawn tightly against the concrete already in place.

Where a feather edge might be produced at a construction joint, as in the sloped top surface of a wing wall, inset form work shall be used to produce a blocked out portion in the preceding layer which shall produce an edge thickness of not less than six inches in the succeeding layer. Work shall not be discontinued within 18 inches of the top of any face unless provision has been made for a coping less than 18 inches thick, in which case, if permitted by the Engineer, construction joints may be made at the under side of the coping.

In construction joints approved metal baffle plates of copper, zinc alloy or sheet lead shall be placed not less than three inches from the face of the concrete and shall extend at least three inches into the concrete on each side of the joint. Metal baffle plates shall not be used where they may be subject to the action of sea water, sewage or other deleterious materials; baffle plates of rubber or other approved material shall be used under these conditions.

B. BONDING TO CONCRETE ALREADY SET.—In bonding new concrete to concrete already set, the surface of the old concrete shall be thoroughly cleaned, roughened, wetted with clean water, and then flushed with a mortar composed of equal parts of the cement and sand specified for the new concrete, before new concrete is placed adjacent thereto.

C. EXPANSION JOINTS. Expansion Joints shall be constructed in all structures as shown on the plans and as directed according to the requirements of the Special Provisions.

D. EMERGENCY.—When the work of placing concrete is unexpectedly interrupted by breakdowns, storms or other causes and the concrete as placed would produce an improper construction joint, the Contractor shall either re-arrange the concrete, or continue mixing by hand, if necessary, until a suitable arrangement is made for a construction joint. When such a joint occurs at a section on which there is a shearing stress, the Contractor shall provide an adequate mechanical bond across the joint by forming a key, inserting reinforcing steel or by some other satisfactory means, which will prevent a plane of weakness.

Weep holes shall be provided on all structures as indicated on the plans, and as directed. Ends of weep holes that are to be covered by filling material shall be protected by not less than one cubic yard of screened gravel or crushed stone.

Wrought iron pipe drains shall be provided for bridge superstructures when indicated on the plans.

PROTECTION, CURING AND FINISHING

A. PROTECTION.—Precautions shall be taken to thoroughly protect the concrete from damage by rain, sun, and cold weather during and after laying.

Concrete shall not be poured in cold and freezing weather except under full responsibility by the Contractor and only under the conditions outlined. Any concrete damaged by exposure shall be removed and replaced by the Contractor at his own expense.

During cold weather the concrete shall be fully protected until properly set and hardened to prevent damage. The concrete shall be placed and maintained at a minimum temperature of 50 degrees for the entire curing period.

In case of extreme weather, the Commissioner may, at his discretion, raise the lower limiting temperature for water, aggregate, and mixed concrete.

During warm and dry weather, and as directed, all new concrete shall be kept well shaded from the sun and well sprinkled with water until set.

B. **CURING.**—The concrete shall be kept fully saturated and protected against any drying action by an approved method of curing for the following periods after placing of concrete:

Not less than five days for Standard Cement Concrete

Not less than two days for High Early Strength Concrete

C. **FINISHING.**

1. *Upper Horizontal Surfaces.*—All upper horizontal surfaces not subjected to wear, such as the tops of handrail posts and caps and the tops of parapets, copings, walls and seats shall be formed by placing an excess of material in the forms and removing or striking off such excess with a wooden template, forcing the coarse aggregate below the mortar surface. The use of mortar topping will in no case be permitted.

After the concrete has been struck off as above described, the surface shall be thoroughly washed and floated with a wooden, canvas or cork float, the operation to be performed by skilled and experienced concrete finishers. Before the last finish has set, the surface shall be lightly striped with a fine brush to remove the surface cement films, leaving a fine-grained, smooth but sanded texture.

Horizontal surfaces such as sidewalks and slabs shall be struck off with a screed or template and finished with a wooden float.

Deck slabs which are to be finished roadway pavement shall be struck off with a screed or template and finished by brooming. The brooms shall be an approved type. Brooms which have become worn or are otherwise unsatisfactory shall be discarded. Sufficient time shall be allowed before brooming is started to permit surplus water and laitance to rise to the surface. The brooming operations shall be completed before the concrete is in such condition that it will be torn or unduly roughened by the brooming operation, and before initial set has developed.

2. *Surfaces not Exposed to View.* Immediately after the forms have been removed and form ties cut back from the face of the concrete, all voids and cavities shall be filled with a stiff mortar of the same composition and air-entrainment as the mortar in the original concrete mix.

3. *Surfaces Exposed to View.* Immediately after the forms have been removed from surfaces which are exposed to view, the surfaces shall have all projections and irregularities carefully removed and all cavities filled with stiff mortar of the same composition as the mortar in the concrete. The same brand and color of cement, and the same kind and color of aggregate shall be used for filling cavities as was used in the original concrete mix. The surface film of all such pointed surfaces shall be carefully removed before setting occurs.

If in the opinion of the Commissioner these surfaces do not present a smooth surface of even texture and appearance, then the following finish shall be repeated as many times as the Commissioner deems it necessary in order to secure a satisfactory finish. The Commissioner shall be the sole judge of the amount of rubbing which will be required.

Immediately after the forms are removed, and necessary patching and smoothing is done, the surface shall be wetted with clean water and rubbed with a No. 16 carborundum brick or other abrasive of equal quality until even and smooth and of uniform appearance, without applying any cement or other coating. The final finish shall be obtained by a thorough rubbing with a No. 30 carborundum brick or other abrasive of equal quality.

After the final rubbing is completed, the surface shall be thoroughly drenched and kept wet for a period of seven (7) days, unless otherwise directed.

No rubbing will be permitted in cold or freezing weather.

PROTECTION OF PIPES AND CONDUITS.—The Contractor shall care for and protect from injury all pipes, wires and conduits encountered in the work by furnishing and maintaining suitable supports

(including placing steel bars where directed) on the bridge during construction. The Contractor shall also furnish and place fibre or metal conduits with junction boxes of satisfactory dimensions with covers of non-corrosive metal for electric wiring as indicated on the plans and as directed by the Commissioner.

The Contractor shall provide suitable openings from the abutments, walls and piers for pipes and electric wiring as shown on the plans and as directed by the Commissioner. If required, the opening shall be bricked up with brick masonry in a satisfactory manner.

REMOVAL OF FORMS AND LOADING ON STRUCTURES.—The requirements hereunder shall apply to all supports of forms; so that, for interpretation of this section, forms shall include all supports of the actual forms for enclosing of the concrete.

The forms for any portion of the structure shall not be removed until the concrete is strong enough to avoid possible injury from such removal. Forms shall not be removed or disturbed without the prior approval of the Commissioner. Forms (supports) shall be removed in such a manner as to permit the concrete to uniformly and gradually take the stresses due to its own weight.

If test cylinders are taken for the concrete in the members of structure, the forms shall be left in place until the concrete has attained the strength designated in the following table and, regardless of strength attained, for the minimum period indicated. In the absence of cylinder tests, the forms shall remain in place for the period specified under minimum loading period. However, in order to facilitate any particular finishing operations, side forms carrying no load may be removed 24 hours to 72 hours (depending on weather conditions and cement, or cement with admixtures, used) after the placing of the concrete has been completed, subject to the approval of the Commissioner; and with the complete curing process to be continued as required.

No superimposed load of any kind or for any purpose will be allowed on a structure before the expiration of the period of time prescribed in the table, whether or not the forms have been removed.

FOR STANDARD-CEMENT CONCRETE

Length of Span	Minimum Strength of Concrete in Pounds per Square Inch	Minimum Days for Forms in Place	Minimum Days Before Loading
Up to 10 feet	2,000	7	10
Over 10 feet — Up to 20 feet	2,500	10	14
Over 20 feet — Up to 30 feet	2,500	12	18
Over 30 feet	2,500	14	21

FOR HIGH-EARLY-STRENGTH-CEMENT CONCRETE

Length of Span	Minimum Strength of Concrete in Pounds per Square Inch	Minimum Days for Forms in Place	Minimum Days for Loading
Up to 10 feet	2,000	3	3
Over 10 feet — Up to 20 feet	2,500	5	5
Over 20 feet — Up to 30 feet	2,500	8	8
Over 30 feet	2,500	10	10

In the case a particular increase in strength of concrete in a particular period of time ranging from that attained by use of standard-cement to that attained by use of high-early-strength is required by the contract, or is directed or approved by the Commissioner; (such increase being attained by an extra amount of standard-cement or by the use of particular amounts of approved admixtures), the time periods as required in tables above shall be adjusted proportionally to fit the particular time in which the stated strength is attained by such procedure.

The time requirements provided in both the above tables date from the completed placing of concrete in the member, and are the minimum requirements for the most favorable weather conditions. Longer periods, as directed by the Commissioner, will be required to compensate adequately for adverse weather conditions.

For a concrete deck supported on steel stringer beams or floor beams, the span will be considered as the distance between centers of beams; for composite concrete and steel beams, concrete slab, T-beams, and girders, the distance between center lines of main bearings; and for arches and rigid frames, the distance between springing lines. The measurement in all cases shall be taken parallel to the main reinforcement.

If a pouring sequence is not stated on the plans or in the Special Provisions of a contract which includes the construction of a continuous span structure, the forms for the entire continuous group shall remain in place until every span of the group has been supported for the minimum required period of time.

No backfill or any other operation that could in any way cause stress in the concrete shall begin prior to the period of time required before loading of the structure.

PROTECTION OF PIPES AND CONDUITS.—The Contractor shall care for and protect from injury all pipes, wires and conduits encountered in the work by furnishing and maintaining suitable supports (including steel bars) where directed on the bridge during construction.

The Contractor shall provide suitable openings in the abutments, walls, piers, and superstructure as shown on the plans and as may be directed. If required, the opening shall be filled with brick masonry in a satisfactory manner.

CONCRETE CONSTRUCTION DURING COLD WEATHER.—Concrete shall not be placed in cold or freezing weather except under full responsibility by the Contractor and only under the conditions outlined below; and provided that any concrete damaged by exposure or otherwise shall be removed and replaced by the Contractor entirely at his own expense.

No concrete shall be placed when the atmospheric temperature in the shade and away from artificial heat is below 35 degrees F., or when the temperature may be expected to drop below 30 degrees F. within 24 hours, except upon permission in writing by the Commissioner, which shall not be granted until satisfactory provisions have been made to protect the work.

Under such conditions, the newly placed concrete shall be protected by adequate housing or covering and heating; with the exception of particular concrete which may be protected by other satisfactory methods, but which shall be subject to the approval of the Commissioner.

Where it may be expected that considerable heat will be generated by the hydration of the concrete, and in some cases where heat is not rapidly dissipated, suitable coverings may be used to protect concrete. Heavy footings in which the concrete is placed at a temperature of 70 degrees F. and protected by the surrounding earth except on top may be protected down to an air temperature of about 15 degrees F. by a tarpaulin placed over the top with an air space between the concrete and the tarpaulin. Mass concrete, when concrete as such is so specified on the plans or so defined by the Commissioner, may be protected down to an air temperature of about 20 degrees F. by enclosure with tight wooden forms at least 7/8 inch in thickness and the concrete is placed at a temperature of 70 degrees F.; except at corners and edges. Double sheathing, insulation board or tarpaulins with a dead air space between the covering and the forms shall be placed to equally protect such edges and corners. Enclosures and added artificial heat will be required for such concrete placed at lower air temperatures.

The Contractor shall have readily available for installing on the work adequate material for the proper enclosure or covering of the concrete together with adequate equipment for satisfactory heating as may be necessary.

As much as possible of any enclosure for protection shall be in place before depositing of any concrete and the remainder shall be installed as rapidly as possible in order to reduce heat losses to a minimum.

The temperature of the concrete inside the enclosure shall be held above a minimum temperature of 50 degrees F. and the temperature shall not be raised above a 70 degree F. to 80 degree F. range. This temperature shall be maintained above 70 degrees F. for the first three days or above 50 degrees F. for the first five days after the concrete is completed in place; except periods of time may be reduced when satisfactory strength is attained sooner as with the use of high-early-strength-cement, then a

minimum of 70 degrees F. for two days or 50 degrees F. for four days will be required. In any case, the periods of time provided above are minimum requirements and extensions of these periods of time will be required provided that such may be necessary to develop satisfactory strength in the concrete.

At air temperatures below freezing gradual cooling of the concrete will be required after the above stated periods of time for protective heating; and shall be a cooling of not more than 20 degrees F. during each 24 hours.

Heating within the enclosure shall be attained by such means of artificial heat as will maintain the temperatures specified continuously and with a reasonable degree of uniformity in all parts of the enclosure. All exposed surfaces of concrete within the enclosure shall be kept sufficiently moist to prevent any rapid drying of the surface concrete with possible resulting damage to the concrete in place. Heating appliances shall not be placed in such a manner as to endanger the enclosure, forms or supports, or expose any area of concrete to rapid drying out or other injury due to excessive temperatures.

Should the Contractor wish to secure permission to use other methods than those provided above for protective retaining of heat within the concrete or direct protective heating of the concrete by adequate facilities for same, such request shall be made in writing by him to the Commissioner and shall include verifiable evidence of satisfactory results obtained by use of such methods. Other methods than those provided herein shall not be used unless approved in writing by the Commissioner, and then only under the full responsibility of the Contractor.

DEFECTIVE WORK.—Any defective work discovered after the forms have been removed shall be immediately removed and replaced. If the surface of the concrete is bulged, uneven or shows excessive voids or form joint marks which cannot be repaired satisfactorily, the entire section shall be removed and replaced. All repairs and renewals due to defective work shall be done at the expense of the Contractor.

MEASUREMENT AND PAYMENT

Cement concrete masonry will be measured by the cubic yard and the quantity shall be determined in accordance with the dimensions shown on the plans and such alterations of the plans as are specifically ordered in writing by the Commissioner.

Reinforcing bars will be measured by the pound. The weight of bars shall be the product of the length as shown on the approved plans and schedules and the standard weight per foot of length as adopted by the Concrete Reinforcing Steel Institute. Wire or metal clips used in making the bars into mats will not be considered as reinforcement and the Contractor will receive no additional compensation for their use.

The weight of wire mesh shall be the computed weight incorporated in the structure in accordance with the plans based on the standard weight accepted by the trade for the unit area of the particular mesh. The weight of chairs for support of reinforcing steel will not be included in the weight for payment.

Cement concrete masonry will be paid for at the contract unit price per cubic yard under the particular Item for Cement Concrete Masonry of the class and type required, as shown on the plans or as directed, complete in place and accepted, and this price shall include full compensation for all construction and removal of forms; all work on construction joints, expansion joints, weep holes and drains, all finishing of concrete, all materials (except reinforcement) and including grout, ornamental concrete castings, wrought iron pipe drains, tar paper, asphalt, mastic, preformed filler, flashings and water stops; all tools, labor, machinery; heating and protecting; and such other appliances, equipment and materials not otherwise herein provided for that may be required to execute the work properly in accordance with these specifications.

The Contractor shall have no claims for special allowances for extra cement or apparent shrinkage due to inaccurate proportioning or control, bulging of forms, spilling, waste or for other job conditions within his control.

Payment for additional cement required to be used in proportioning by volume and in pouring of concrete under water shall be included in the contract unit price paid for the particular class of cement concrete masonry specified or directed.

Steel reinforcement including wire mesh will be paid for at the contract unit price per pound under the Item for Steel Reinforcement for Structures, complete in place, and this price shall include full compensation for all materials, labor, tools, equipment and other incidentals necessary to complete an acceptable installation. The weight of chairs or other devices for support of reinforcement shall not be included in the pay weight of steel reinforcement.

Galvanized steel curb bars, wrought iron or steel dowels, and eye bolts will be paid for at the contract unit price per pound under the Item for Steel Reinforcement for Structures.

Holes for dowels shall be drilled by the Contractor without extra compensation.

PAYMENT ITEMS

F4-1 — Cement Concrete Masonry	Cubic Yards
F4-2 — Steel Reinforcement	Pounds

The temporary pipe connections with new underdrains from old drains are to be built and removed at the Contractor's expense.

PAYMENT ITEMS

G2-1 — Clay Pipe Sewer and Concrete Pipe Surface Drain (..... inch).....	Linear Feet
G2-2 — Clay Pipe Sewer and Concrete Pipe Surface Drain (..... inch).....	Linear Feet
G2-3 — Clay Pipe Sewer and Concrete Pipe Surface Drain (..... inch).....	Linear Feet
G2-4 — Concrete Pipe Surface Drain (..... inch).....	Linear Feet
G2-5 — Concrete Pipe Surface Drain (..... inch).....	Linear Feet
G2-6 — Concrete Pipe Surface Drain (..... inch).....	Linear Feet
G2-7 — House and Catch Basin Drains.....	Linear Feet
G2-8 — Y Branches.....	Each
G2-9 — Slants or Pipe Connections.....	Each

SECTION G-3

CONCRETE AND BRICK MASONRY

(MANHOLES, CATCH BASINS, ETC.)

GENERAL

The manholes, catch basins, drop inlets and other appurtenant structures are to be constructed of brick, laid in cement mortar to a line with the beds in the line of the radii of the curves, and with as close joints, not exceeding one-quarter ($\frac{1}{4}$) inch for facework, as may be from time to time directed; other brick masonry is to be laid as shown on plans or as directed by the Commissioner.

MATERIALS

Lumber.—Lumber shall be furnished and used in construction of wooden foundations for the sewers, manholes, drains and catch basins and for other purposes, as shown on plans or as directed by the Commissioner. All lumber for permanent use shall be sound, straight-grained and free from shakes, loose knots or other defects liable to impair its strength or durability. All “matched” and “grooved” sheeting shall have one planed side.

Portland Cement Concrete.—Concrete shall be composed of the quality ingredients, and furnished and placed in accordance with all the applicable provisions and requirements of Section F-4 for the particular Class or Classes of concrete called for by the Special Provisions and/or plans, if any.

Mortar.—The mortar shall be composed of cement, thoroughly mixed with sand in a manner and in boxes approved by the Commissioner; these materials are to be thoroughly mixed dry, a quantity of water is then to be added just sufficient to make a paste of proper consistency, and the paste thoroughly worked with hoes or other tools. No box used for measuring shall be less than twelve (12) inches in depth.

The materials shall conform to the applicable requirements of Section F-4 and, unless otherwise directed by the Commissioner, shall be mixed in the following proportions, by measure: For brick masonry and plastering, one (1) part cement to two (2) parts sand; for mortar joints in pipe, one (1) part cement to one (1) part sand.

If the Commissioner requires a change in these proportions, he will make what is, in his judgment, a fair compensation or deduction therefor. No mortar is to be used that has become hard or set.

Clay Brick.—All sewer brick shall conform to the American Society for Testing Materials, “Serial Designation C-32,” Grade MA, size No. 1 or 2, and all brick for manholes and catch basins shall conform to the American Society for Testing Materials, “Serial Designation C-62,” Grade SW. They shall be of clay, compact in texture, thoroughly burned hard and evenly throughout, shall be rectangular in cross-section and of uniform sizes, with straight parallel edges, square corners, free from checks or cracks extending into the body of the bricks, and from pebbles or other foreign materials; and shall measure not less than $2\frac{1}{4}$ by $3\frac{3}{4}$ by 8 inches, nor more than $2\frac{1}{2}$ by 4 by $8\frac{1}{2}$ inches; and shall after being thoroughly dried, and then immersed in water for twenty-four (24) hours, absorb not more than twelve (12) per cent of water by volume, and shall have a compressive strength of not less than three thousand (3,000) pounds per square inch laid flat.

Cement Concrete Brick.—All brick for manholes on surface drains and catch basins shall conform to the American Society for Testing Materials, “Serial Designation C 55,” Grade A. They shall be of cement concrete, compact in texture, thoroughly cured throughout, shall be rectangular in cross section and of uniform sizes, with straight parallel edges, square corners, and free from checks or cracks extending into the body of the bricks. They shall measure $2\frac{1}{4}$ by $3\frac{3}{4}$ by 8 inches and shall have a permissible variation of $\frac{1}{16}$ inch in depth, $\frac{1}{8}$ inch in width and $\frac{1}{4}$ inch in length, and after being

thoroughly dried and then immersed in water for twenty-four (24) hours, absorb not more than twelve (12) per cent of water by volume, and shall have a compressive strength of twenty-five hundred (2,500) pounds per square inch laid flat.

Steel.—All reinforcing steel and structural steel shall conform to the applicable requirements of Sections F-4 and F-5 relating to General Description, Materials, Construction Methods, Measurement and Payment, and to the Special Provisions and plans, if any.

CONSTRUCTION METHODS

Whenever the atmospheric temperature falls to 35 degrees Fahrenheit, the brick and sand shall be heated to 80 degrees Fahrenheit, and the water to not more than 120 degrees; and as soon as the mortar is sufficiently set it shall be protected from freezing and inclement weather, either by backfilling or by completely covering with canvas, burlap, or other suitable material. Covering with boards alone will not be considered adequate.

Brick masonry shall not be laid after the atmospheric temperature has fallen to 32 degrees Fahrenheit, except by special permission of the Commissioner, in each particular instance.

Masonry, either brick or concrete, shall not be left unprotected overnight nor at any time during the day when work of actual construction is suspended for more than one (1) hour.

The Contractor shall not work on masonry during such days as, in the opinion of the Commissioner, good work cannot be obtained on account of inclement weather or frost. Due allowance for such days will be made by the Commissioner in connection with the date of completion.

Masonry shall not be placed upon frozen earth foundations, nor shall brick masonry be placed wherever snow or ice is present.

Pipe connections are to be built into the masonry where required and, if not connected, are to be properly plugged by vitrified stoppers and sealed with asphaltic compound.

Pipe connections laid in masonry sewers or surface drains are to extend completely through the masonry, and payment therefor shall be included under the items for concrete furnished and placed. Subject to the provisions of Section G-2, all pipe laid beyond and connected therewith will be paid for per linear foot of new pipe actually laid beyond the connection.

The Contractor shall place cradle, furnished by the City, for carrying water pipes through concrete arches found to interfere with the line of pipe, and furnish and place therein sand for the proper bedding of the pipe. The cost of this provision, including cutting of centers or forms and all other incidental work, will be paid for under the item of the proposal marked "Pipe Cradle", in all cases where the necessity for using cradle is foreseen and provided for in the contract. In other cases it will be paid for as Extra Work on the written order of the Commissioner.

Where, in the opinion of the Commissioner, built-in-place concrete sewers require a protective coating, the interior surface of the structure shall be painted by brush or spray gun with two coats, applied cold, of an inert coal tar base product such as Bitumastic No. 50, or equal.

All surfaces shall be cleaned of all dust, form oil, curing compound, or other foreign matter before painting.

Each of the two coats shall be applied at an approximate rate of one (1) gallon per two hundred (200) square feet.

All forms for concrete shall be furnished by the Contractor. They shall be sufficiently tight to prevent any leaking or draining of the concrete. All interior forms are to be built with curves of the radii shown on the plans, with surfaces truly planed to the exact shape and dimensions indicated thereon, or suitable metal forms may be used. All forms are to be properly lubricated to prevent adhesion of the concrete; those for invert or side walls are to be left in place until the concrete has been in place at least twenty-four (24) hours and as much longer as may be ordered by the Commissioner. Unless otherwise directed by the Commissioner, and except as otherwise specified hereinafter, the centers on which the arches are formed shall not be removed until the concrete in the arch has been

"Cured" in place at least seventy-two (72) hours nor until the backfill is raised at least two (2) feet above the top of the arch, and no more load is to be placed until such time as the Commissioner may direct.

Before being lubricated all forms are to be made clean and free from cement, dirt, ice or frost; hot water or steam is to be used if necessary for cleaning them. Especial care shall be taken that none of the lubricant gets on any portion of the concrete against which other concrete is to be placed. If at any time lubricant is found in such places it is to be carefully and entirely removed and the surface of the concrete chipped to insure a good bond, or treated with acid as hereinbefore described if so required by the Commissioner. Forms used to hold the concrete in place are to be set true to line and grade, and firmly secured, so that they will not get out of place while the concrete is being placed.

In laying brick masonry the bricks are to be thoroughly wetted just before laying. Each brick is to be completely imbedded in mortar under its bottom, on its sides and on its ends at one operation; care is to be taken to have every joint full of mortar. The hardest and most regular of the bricks are to be used for the inverts of the manholes and drop inlets.

No masonry is to be laid in water; no water is to be allowed to rise on any masonry until it has set at least twenty-four hours, and no drainage is to be effected over or through the sewer or drain without permission from the Commissioner.

The exterior surfaces of all manholes, and the interior and exterior surfaces of all catch basins, shall be plastered with a three eighths ($\frac{3}{8}$) inch coating of cement mortar.

MEASUREMENT AND PAYMENT

The quantity of concrete to be paid for will be the volume of concrete in place, in conformity with the plans and to the orders of the Commissioner, as set forth in these specifications. In determining said volume the Engineer shall use such actual measurements or standardized cross sections as are respectively called for by the provisions of these specifications. It shall not include the space occupied by pipes, or, where steel is separately furnished, of steel other than rods, bars, expanded metal, or similar reinforcement imbedded therein.

For the estimating of quantities in which the computation of areas by geometric methods would be unduly laborious, it is hereby stipulated and agreed that the planimeter shall be considered an instrument of precision adapted to the measurement of such areas.

The finished sides and bottoms of the excavations, or the inside faces of the sheeting or platform, as the case may be, shall be so located as to admit between them the full cross section of the concrete structure on its normal axis. Only such concrete within the lines of the normal concrete cross section, as shown on the plans, will be paid for at the respective prices named in the proposal.

The prices bid for concrete, of whatever description, shall include the cost of furnishing, placing, and removing all forms and the placing of pipe slants or pipe connections as directed by the Commissioner.

The prices bid for manholes are to include the cost of furnishing and placing all bull's-eyes, bulk-heads, etc., and of placing all slants, stubs, etc. The prices bid for special or "jug-handle" manholes are to include the cost of placing all bends, T's, and straight pipes forming the inlet or inlets and of furnishing and placing the concrete in which these pipes are to be encased. The prices bid for combination manholes are to include the cost of placing the combination castings. Except as set forth above, all concrete and steel used in manhole construction will be paid for under the respective items of the proposal for that material. The prices bid for manholes on old sewers or drains are to include the cost of removing such portions of existing structures as may be required.

The prices bid for catch basins are to include the cost of labor and materials necessary to cut and fit new gutter-mouth stone to old edgestone. Where frames and covers cannot be furnished, a double layer of 2-inch planks, securely spiked together, shall be placed over the opening of the catch basin. Payment for this work shall be made under the item of the proposal marked "Lumber for Sheeting, etc."

The quantity of brick masonry to be paid for under the item of the proposal marked "Other Brick Masonry" will be determined by measurements of the number of cubic yards in place in conformity with the plans and to the orders of the Commissioner.

Payment for coal-tar base protective coating will be made on the basis of the measured amount of area covered at the unit price per square foot bid under the item specified in the Proposal.

PAYMENT ITEMS

G3-1 — Portland Cement Concrete, Class....(.....)	Cubic Yards
G3-2 — Special or Standard Manholes (on Sewer).....	Each
G3-3 — Special or Standard Manholes (on Surface Drain).....	Each
G3-4 — Catch Basins.....	Each
G3-5 — Drop Inlets.....	Each
G3-6 — Standard Manholes (on Existing Structures).....	Each
G3-7 — Combination Manholes.....	Each
G3-8 — Other Brick Masonry.....	Cubic Yards
G3-9 — Guttermouths Cut in Existing Edgestone.....	Each
G3-10 — Old Catch Basins Dismantled.....	Each
G3-11 — Existing Manhole Inverts and Walls Rebuilt.....	Each
G3-12 — Reinforcing Steel.....	Pounds
G3-13 — Coal-Tar-Base Paint.....	Square Feet

SECTION G-4

TEMPORARY AND PERMANENT RESURFACING

GENERAL DESCRIPTION AND CONSTRUCTION METHODS

Within one week following the completion of the refilling in paved roadways or sidewalks the refilled trenches shall be excavated to a depth of two (2) inches below and parallel to the finished surface and then compacted to an even surface by rolling or ramming. Upon this subgrade the Contractor shall place a surface of Bituminous Concrete Class I or cold patch, as determined by the Commissioner, compressed by rolling to a finished thickness of two (2) inches to the grade and shape of the adjoining finished surface.

The work of patch paving shall not commence before thirty (30) days after the trenches have been backfilled. The methods used and materials furnished shall conform to the "Standard Specifications," "Patch Paving Specifications for Repairing Roadway and Sidewalk Areas," on file at the Commissioner's office.

Permanent paving of trenches in asphalt, bituminous concrete, macadam or similar paved streets shall be commenced not sooner than thirty (30) days and not later than sixty (60) days after the laying of the temporary pavement has been completed. The work of permanent paving shall be done in the presence of a Highway Division Inspector and in accordance with the following specifications.

All temporary paving and existing backfill shall be removed to a depth of eight inches. Any material disturbed below the depth specified for the new base shall be properly tamped and compacted. All edges of existing base shall be cut vertically, and back six inches from edge of backfilled trench so that new base will rest on undisturbed soil. The cutting line of old pavement must be vertical and reasonably straight from angle point to angle point where the opening is of irregular shape and made rectangular where it is practical to do so. No ragged or irregular edges will be permitted. The existing pavement on cement concrete base shall be stripped back for a distance of 2 inches from edge of base so that the new pavement will overlap joint between old and new base.

Sheet asphalt pavements shall be restored by providing a six (6) inch Portland Cement concrete base and a one course sheet asphalt wearing surface, two (2) inches in depth.

Bituminous concrete or macadam pavements shall be restored by providing a six (6) inch Portland Cement concrete base and a one course bituminous concrete wearing surface, two (2) inches in depth.

The concrete base shall be covered by the bituminous concrete wearing surface or sheet asphalt wearing surface within 72 hours after the base is laid and shall be protected by lights and horses each night until the wearing surface is laid. Under no conditions shall more than one traffic lane be left at night obstructed by barriers.

Asphalt mix for sheet asphalt or bituminous concrete and methods of placing shall conform to the standard specifications of the Highway Division of the Public Works Department, City of Boston.

Sheet asphalt and bituminous concrete wearing surfaces, after spreading and rolling, shall be two (2) inches in depth and flush with the existing pavement. The vertical surfaces of the existing pavement shall be painted with asphalt cement and after the paving mixture has been spread it shall be thoroughly compressed with a tandem roller of not less than ten tons. Along curbs and similar structures and all places not accessible to a roller the mixture shall be compacted with tampers and smoothers.

Portland Cement concrete base shall be placed upon a properly prepared subgrade, and shall be equal to Class B of the standard specifications of the Highway Division, Public Works Department, City of Boston, and shall be laid 6 inches in depth, which after spreading and tamping shall be two (2) inches below and parallel to the existing finished grade of the street.

The Contractor shall maintain the street and sidewalk surface over all excavations in a safe and satisfactory condition for a period of sixty-one (61) days after the completion of the contract; if he fails, in the opinion of the Commissioner, to do so the City will make the necessary repairs and the cost of the work will be deducted from the amount due the Contractor on the final estimate.

The Contractor shall be responsible for any accident that may occur on account of the defective condition of the street or sidewalk surface.

Cold patching methods and the materials furnished therefor shall conform to the "Specifications For Cold Bituminous Patching Mixtures" of the Highway Division.

Permanent resurfacing methods and the materials furnished therefor shall conform to the "Patch Paving Specifications for Repairing Roadway and Sidewalk Areas" of the Highway Division.

All specifications are on file at the Commissioner's office.

MEASUREMENT AND PAYMENT

Payment for Item G4-1 will be made at the contract unit price per square yard of bituminous cold patch materials furnished and laid for resurfacing trenches in artificial stone sidewalks and in the various types of paved roadways.

Payment for Item G4-2 will be made at the contract unit price per square foot of replaced artificial stone sidewalks and driveways, complete in place.

Payment for Item G4-3 will be made at the contract unit price per square yard of six (6) inch Portland cement concrete base and two (2) inch bituminous concrete wearing surface at designated locations, complete in place.

PAYMENT ITEMS

G4-1 — Cold-Patching Sidewalk and Roadway Trenches	Square Yards
G4-2 — Artificial Stone Sidewalks and Driveways Replaced	Square Feet
G4-3 — Bituminous Concrete Wearing Surface on P. C. C. Base	Square Yards

PART VII

STANDARD SPECIFICATIONS OF WATER DIVISION

GENERAL PROVISIONS FOR WATER DIVISION

Including the General Provisions set forth hereinbefore under the Standard Specifications of the Highway, Bridge and Sewer Divisions, and without limiting the generality thereof, the following General Provisions are added at this Part VII of the Standard Specifications of the Public Works Department as being conditions more specifically pertinent to Water Works.

(a.) The Contractor shall convey, at his own expense, the pipes and other materials, furnished by the City from the particular Water Division Yard at 710 Albany Street, Boston, to his work as rapidly as the progress of the work demands. The Contractor shall be responsible for loss incurred or damage done to the pipes and other materials furnished by the City from the time of their delivery to him at the storage place until work is accepted by the City.

(b.) The Contractor shall be required to haul the inspector's shanty from the district yard wherein same is stored to the site of the initial job of the contract and do all the hauling of the shanty from street as the work advances. At the completion of the work the Contractor shall haul the shanty to the street or district yard designated by the Commissioner.

(c.) The City will furnish the pipes, special castings, gates, hydrants, gate boxes, service shoes, tubes and caps, frames and covers, hydrant drain fittings and other materials, and shall deliver the same to the Contractor at the Water Division yard at 710 Albany Street, Boston, and shall make the service pipe and hydrant drain connections.

(d.) The loading of the pipes and other materials upon the trucks of the Contractor at the Water Service yard shall be done by the Contractor, and the trucking and unloading shall be done by the Contractor. The unloading of the pipes and other materials shall be done with extreme care so as not to crack them or injure the street surface. Dropping the pipes, special castings, gates, hydrants, etc., directly from the trucks or trailers upon the ground will not be permitted; suitable and effective buffers or runners must be provided. The Contractor will be held responsible for any damage done or loss incurred to the pipes or other materials from the time of their delivery to him until they are accepted in the completed work. The Contractor will load the pipes and other materials only on trucks or trailers suitable for the purpose.

(e.) The Contractor shall do the trucking and unloading as above specified; shall do the excavating, pipe laying, refilling and other work; shall furnish the lead, jute packing, blocking, wedges, timber and all necessary street surfacing materials required for the work; shall return to the Water Service yard all pipes, cut pieces, special castings, gates, hydrants and other materials trucked by the Contractor to the work and not used, also such pipes, special castings, gates, hydrants, etc., removed from the trench, and retained by the City; shall have as his property all old water pipes and lead joints removed from the trench excepting such pipes and special castings as shall be designated by the Commissioner to be retained by the City, and shall furnish and do everything, except as herein otherwise provided, necessary to complete the work in accordance with the terms of this contract.

(f.) The pipes and other materials shall be delivered to, and received from, the Contractor at the Water Division yard during the hours of 8 A.M. to 12 noon and 1 P.M. to 4.30 P.M., every week day excepting Saturdays, Sundays and holidays.

SECTION H-1.

LAYING WATER PIPE

H 1-1 through H 1-7, etc. TRENCHES IN EARTH EXCAVATION

GENERAL

The work to be done under these Items consists of excavating trenches and laying pipes of the kinds and sizes shown on the plans and as specified in the Special Provisions, including backfilling and incidental work, all in accordance with the Uniform Special Provisions and these specifications.

The Contractor shall furnish all labor, equipment and materials (other than the pipes, special castings, gates, hydrants, gate boxes, service shoes, tubes and caps, frames and covers, hydrant drain fittings and other materials).

MATERIALS

All materials to be furnished by the Contractor shall conform to all the applicable requirements specified hereinbefore throughout the Standard Specification of the Public Works Department.

CONSTRUCTION METHODS

(a.) TRENCHES:—Trench excavation in earth shall be made to such widths and depths and in such a manner as to allow the pipe to be properly laid and calked. The depth of trench shall be at least six (6) feet below the established grade or existing street surface; the width shall be not less than two and one half ($2\frac{1}{2}$) feet in laying new work and not less than three (3) feet in relaying work. In sizes of pipe 16 inches and over, trenches shall be two (2) feet wider than the inside diameter of pipe. Where established grade of street calls for a trench depth greater than six (6) feet the trench width designated above shall apply.

The prices bid on the various Items of the Proposal for laying pipe shall include the cost of all materials and labor for sheeting and bracing the trenches if required.

(b.) BLOCKING:—The blocking furnished by the Contractor shall be new spruce plank, 1 inch and 2 inches in thickness, not less than 6 inches wide and as long as specified in the Special Provisions. Each length of straight pipe shall have one set of blocking near the bell. In case of trenches excavated in rock sufficient blocking shall be furnished to give the pipe proper bearing on the trench bottom and correct grade alignment.

The blocks must be bedded firmly and level across the bottom of the trench and when any block has been sunk too deep, additional blocking of suitable thickness shall be placed to bring the pipe to the required grade. A sufficient quantity of wedges 12 inches long, of 4-inch by 4-inch spruce, shall be furnished to properly hold gates and special castings in place, and new 4-inch by 4-inch spruce timber shall be furnished to properly brace hydrant pots.

(c.) JOINTS:—The pipes shall be thoroughly cleaned before being laid. The spigots shall be adjusted in the bells so as to give a uniform space for joint which shall be made with T jute packing and new Omaha pig lead, or with lead equally good in the opinion of the Commissioner for the purpose of calking. The jute packing shall be thoroughly packed into the bell so as to leave a space for the lead of at least $2\frac{1}{2}$ inches in depth. Dross shall not be allowed to accumulate in the melting pot, which shall be kept near the point to be poured, and the molten lead, free from dross, shall be poured into the joint in a continuous stream until the joint and the gate are completely filled.

The joints shall be thoroughly calked by competent mechanics, the calking to be done in such a manner as to secure a tight joint without overstraining the iron of the bells.

All joints shall be left fully exposed in view, unless otherwise ordered by the Commissioner, until after the full water pressure of the adjoining system has been turned on to the pipe line under construction, and any defective work shown by this test shall be replaced by satisfactory work.

(d.) GATES, BRANCHES, ETC.:—Gates, branches, hydrants and special castings shall be placed in the line of pipe where required, and no extra allowance will be made for the extra cost of setting the same, due to cutting pipes, etc., beyond the price per linear foot for laying or relaying the pipe.

An allowance shall be made for the materials and labor necessary in making extra joints as per the foregoing paragraphs titled “(c) Joints”.

The number of extra joints will be determined by dividing the total length of main pipe laid in any street as paid for in the estimate by (to be stated in Special Provisions); the quotient obtained shall be deducted from the number of joints actually run and calked, exclusive of intersecting street connection, post hydrant pipe and iron service pipe joints. The difference will be the number of extra joints to be paid for under the foregoing paragraphs titled “(c) Joints”. The number of pounds of lead will be determined by multiplying the number of extra joints times the number of pounds of lead used for that size pipe joint.

(e.) CUTTING OUT PIPE:—The Contractor shall break out the old water pipe as directed by the Commissioner, removing such pipe and special castings as shall be designated by the Commissioner whole and in good condition. In no case shall the water be shut off before 9 A.M. and the work must be so arranged that the water will be turned on not later than 4.30 P.M., nor shall the water be shut off on Sundays or holidays.

The notifying of water takers and the operations of gates and hydrants shall be done under the direction of the inspector and no gate or hydrant shall be opened or shut except in the presence of the inspector.

(f.) THRUST BLOCKS:—All Plugs, Caps, Hydrant Pots, Branches and Bends deflecting more than twenty-two and one-half ($22\frac{1}{2}$) degrees or more on mains eight (8) inches in diameter or larger shall, unless otherwise indicated, be anchored to prevent movement by providing suitable reaction backing or metal harness, as shown on the plans or so specified.

The reaction backing shall be class B concrete in accordance with Section C-1.

Backing shall be placed between undisturbed ground and the fitting to be anchored.

The area of bearing on the pipe shall be as shown or as directed by the Commissioner of Public Works. Unless otherwise directed the backing shall be so placed as to allow the pipe to be accessible for repairs.

Metal harness of tie-rods or clamps of adequate strength to prevent movement may be used instead of concrete backing, if so directed.

(g.) REFILLING TRENCHES:—As soon as practicable after the pipes have been laid the trenches shall be refilled with the best of the excavated material and no improper material shall be placed within two (2) feet of the pipes.

The refilling shall be done by tamping or puddling, as directed by the Commissioner. If the tamping method is used the material shall be spread in layers of not more than six (6) inches in depth, each layer to be leveled and thoroughly rammed with long-handled standard twenty-pound rammers, the ratio of one shoveler to one rammer to be maintained. If the material is puddled the work shall be done in a thorough manner as directed by the Commissioner. In trenches excavated in rock no stone larger than two (2) inches in any dimension shall be used from the trench bottom to a point one (1) foot above the top of the pipe. No stone exceeding six (6) inches in any dimension shall be used in the refilling.

The Contractor will be required to backfill all trenches to a depth of one (1) foot below the existing surface with bank gravel to produce a close-bound, finished surface. All surplus materials shall be removed and disposed of unless otherwise ordered; and the refilling of trenches, the removal of surplus, the cleaning up of the street shall follow closely the pipe laying.

MEASUREMENT AND PAYMENT

(a.) The respective prices bid for laying and relaying water pipe shall include the trucking and unloading of the pipes and other materials, the hauling of inspector's shanty, the removing of all street and sidewalk pavements and surfaces, the removing of all concrete base, the excavation and refilling within the trench limits, the removing of all existing cribwork, sheeting, lumber, tree stumps, roots, railroad ties and abandoned pipe, the excavation and refilling for bell holes, existing main pipe, hydrant pipe and service pipe connections, branches, boxes, hydrant pipes and hydrant boxes; the furnishing of lead, jute packing, blocking and wedges; the handling, laying and jointing of the pipes and appurtenances to conform to the bottom of the excavated trench; the setting and connecting to the main pipe of all new hydrants; the excavation, for each hydrant, of a drainage well of one (1) cubic yard capacity and the furnishing and placing in position of sufficient 2-inch stone to fill same; the notifying of water takers; the operation of gates; the furnishing of all labor required by the driller or plumber; the setting of branches for and the making of all connections with existing main pipe, hydrant pipe and iron service pipes, excepting that when connections to existing main pipe and iron service pipe require pipe-cutting, the length of pipe to be paid for shall be the length of the existing pipe cut out; the necessary pumping of water irrespective of the number of gates leaking or the quantity of leakage; the removal of the old pipes and appurtenances from the trench; the return to the Water Service yard of all pipes and appurtenances not used, also of all old pipes and appurtenances removed from the trench and retained by the City; the setting in place of all boxes complete and all service fittings; the disconnecting of hydrants as shown on the plans and the refilling of such hydrant boxes; the disposal of surplus material; and all incidental work, except that otherwise provided for, connected with the laying or relaying of the pipe, etc.

For the purpose of obtaining a uniform pipe line in relaying where the Commissioner shall direct, the water pipe shall be laid in a new location and the price paid shall be the price under Item H1-4, H1-5, H1-6, etc.

The length of trench of hydrant pipe to be paid for under Item H1-7 shall be measured from the center of branch to the center of the hydrant and shall include the setting of one (1) gate and gate box and one (1) hydrant and the construction of a drainage well.

All pipes laid in intersecting or connecting streets from the main pipe, or for iron service pipe connections to the main pipe, when not otherwise provided for in the proposal, shall be paid for at the price bid for the main pipe size.

The length of pipe to be paid for shall be the length of the pipe line after the pipes have been laid, regardless of size or kind.

The price bid for Item H1-8 shall include the removing of all street and sidewalk pavements and surfaces and the removing of all concrete bases, all the necessary excavation and refilling to enable the Water Service employees to lay and connect service pipe, the furnishing of all labor required by driller and plumber, the setting in place of all service pipe fittings, the disposal of surplus materials, the rolling and resurfacing of paved or dirt streets and all incidental work except that otherwise provided for, etc. The depth of trench shall be at least six (6) feet below the established grade or existing street surface; the width in no case shall be less than two and one half (2½) feet.

PAYMENT ITEMS

H1-1 through H1-3 —	Linear feet of trench and laying of inch water pipe, including all connections and refilling, and all incidental work	Linear Foot
H1-4 through H1-6 —	Linear feet of trench and relaying of inch water pipe, including all connections and refilling, and all incidental work	Linear Foot
H1-7 —	Linear feet of trench and laying or relaying of six (6) inch or eight (8) inch hydrant pipe, including all connections and refilling and all incidental work . .	Linear Foot
H1-8 —	Linear feet of trench for laying or relaying of service pipes, including refilling and all incidental work	Linear Foot

SECTION H-2

SPECIAL EXCAVATION AND FILLING

GENERAL

The work to be done under the Items of this Section consists of only such excavation and refilling that may be designated by the Commissioner and are not covered by the Items under Section H-1.

MATERIALS

Gravel refill shall consist of hard durable stone and coarse sand practically free from loam and clay, uniformly graded and containing no stone having any dimension greater than six (6) inches.

CONSTRUCTION METHODS, MEASUREMENT AND PAYMENT

"OUTSIDE TRENCH" AND "BELOW GRADE" excavation and refilling shall be performed in accordance with all the applicable requirements as hereinbefore specified for trench excavation, and will be paid for under Items H2-1 and H2-2, respectively.

GRAVEL REFILL, to be paid for under Item H2-3, shall include the hauling and placing of bank gravel to a depth of one (1) foot below the existing surface in all trenches and in trenches in rock or other unsatisfactory material, where required, as designated by the Commissioner, including the hauling away from the site of all unsatisfactory or surplus material.

"TRENCHES IN ROCK EXCAVATION," to be paid for under Item H2-4, shall be six (6) inches greater than is required in earth excavation. The width of the trench to be paid for shall not be less than three (3) feet. In sizes of pipe sixteen (16) inches and over an allowance of one (1) foot on each side of the inside diameter of the pipe will be paid for.

Rock excavation below grade will also be paid for at the price bid under Item H2-4.

Only such ledge rock as in the opinion of the Commissioner requires blasting for its removal and boulders of one-half ($\frac{1}{2}$) cubic yard or more in volume will be estimated as rock excavation. All rock shall be measured in excavation, and only rock removed from within the limits above defined will be estimated and paid for.

The price bid for Item H2-4 shall include the rock excavation in all main pipe trenches, service pipe trenches, and hydrant pipe trenches that may be designated by the Commissioner.

PAYMENT ITEMS

H2-1 — Excavation and Refill in "Outside Trench".....	Cubic Yards
H2-2 — Excavation and Refill "Below Grade".....	Cubic Yards
H2-3 — Gravel Refill One (1) Foot Below Surface.....	Tons
H2-4 — Rock Excavation.....	Cubic Yards

SECTION H-3

TEMPORARY AND PERMANENT RESURFACING

The terms, conditions and requirements of Section G-4 of Part VI (Sewer Division) of these Standard Specifications, including all the general description, construction methods, materials, measurement and payment, are hereby made a part of this Section H-3 as fully and to the same effect as if the same had been set forth at length.

PAYMENT ITEMS

H3-1 — Cold-Patching Sidewalk and Roadway Trenches.....	Square Yards
H3-2 — Artificial Stone Sidewalks and Driveways Replaced.....	Square Feet
H3-3 — Bituminous Concrete Wearing Surface on P.C.C. Base.....	Square Yards

SECTION F-5

STRUCTURAL STEEL

GENERAL

This Item shall consist of all structural steel and all other metal work for which payment is not otherwise provided for by an Item in the contract. The work shall be done in accordance with the plans and specifications and as directed.

Where no inspection of materials is arranged for by the Department, the Contractor will be required to submit to the Department, for approval, five certified copies of the mill test report for each kind of steel furnished. These certificates shall certify compliance with the specifications and shall give the chemical analysis of the steel. Any cost involved in furnishing the certificates shall be borne by the Contractor. If the scale weight of any member is less than ninety-seven and one half ($97\frac{1}{2}$) per cent of the computed weight, the member may be rejected.

When the substructure and the superstructure are built under separate contracts, the Contractor for the substructure shall furnish and place the anchor bolts, or the anchor bolts will be furnished by the Contractor for the superstructure and shall be set by the Contractor for the substructure, in accordance with the directions in the Special Provisions.

MATERIALS

STEEL.— All structural, rivet, and eyebar steel and steel castings, pins and rollers shall conform to the requirements of the current edition of the A.A.S.H.O. Standard Specifications for Highway Bridges. Unless specified in the Special Provisions, copper bearing steel will not be required. All steel casting shall be full annealed.

Pins shall conform to A.S.T.M. Designation A108, and grade between 1016 and 1025 inclusive.

Rollers shall conform to A.A.S.H.O. Designation M102, Class C-1.

WROUGHT IRON.— Wrought iron in any of the various forms required shall conform to the particular specification designated below, for the form required to be furnished:

A. **BARS.**— Wrought iron bars shall conform to the requirements of Specification A189 of the A.S.T.M. for Grade B Metal.

B. **PLATES.**— Wrought iron plates shall conform to the requirements of Specification A42 of the A.S.T.M.

C. **SHAPES.**— Wrought iron shapes shall conform to the requirements of Specification A207 of the A.S.T.M.

D. **PIPE.**— Wrought iron pipe shall conform to the requirements of Specification A72 of the A.S.T.M. and shall have distinctly stamped thereon the initials of the maker's name or other distinctive label.

PHOSPHOR BRONZE BEARING PLATES.— Phosphor bronze as used for bearing plates for bridges may be either cold rolled or cast.

1. *Cast Bronze.*— Cast phosphor bronze plates shall conform to the requirements of Specification B22 of the A.S.T.M. for Class B metal.

2. *Cold Rolled Bronze.*— Cold rolled phosphor bronze plates shall have approximately the following composition:

Copper . . . . .	.95%
Tin . . . . .	.5%

The hardness of cold rolled plates shall be not less than that of cast bronze plates as specified above.

EXPANSION BEARING PLATES (SELF-LUBRICATING).—The bronze expansion bearings on the bridges shall conform to the following requirements: The bronze shall be an alloy composed of 85 per cent copper, nine per cent tin, three per cent zinc, two per cent lead, and one per cent nickel. The physical properties shall be 40,000 p.s.i. minimum ultimate tensile strength, 23,000 p.s.i. minimum yield point, 25 per cent elongation in two inches and Brinell Hardness 80. The bearings shall be provided with trepanned recesses (not grooves) filled with a lubricating compound capable of withstanding atmospheric elements. The compound shall consist of graphite and metallic substances with a lubricating binder. The compound shall be pressed into the recesses by hydraulic presses so as to form dense, non-plastic lubricating inserts. The lubricating area shall comprise not less than 25 per cent of the total area. The sliding surfaces of the steel shall be coated with a lubricant, recommended by the manufacturer of the bronze plates, just prior to installation.

CASTINGS.—Iron castings shall conform to the requirements of Specification A48 of the A.S.T.M. Malleable castings shall conform to the requirements of Specification A47 of the A.S.T.M.

Castings shall be boldly filleted at angles and the arrises shall be sharp and perfect.

The castings shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow holes and other defects in positions affecting their strength and value for the service intended. Test bars one (1) inch square placed on supports twelve (12) inches apart in the clear, shall bear a center load of at least 2,500 pounds and deflect 0.15 of an inch before rupture.

STEEL FORGINGS.—Steel forgings shall conform to the Specification for Carbon—Steel and Alloy—Steel Forgings, A.S.T.M. Designation A-235. Class C1 forgings shall be furnished unless otherwise specified.

HIGH TENSILE STEEL BOLTS

1. *Material.*—Bolt, nut, and washer material shall conform to requirements of the current edition of Tentative Specifications for Quenched and Tempered Steel Bolts and Studs with Suitable Nuts and Plain Washers of the American Society for Testing Materials (A.S.T.M. Designation A-325).

2. *Bolt Dimensions.*—Bolt dimensions shall conform to the current requirements for Regular Semifinished Hexagon Head Bolt of the American Standards Association (A.S.A. Designation B18.2), except the radius of fillet under the bolt head shall not be less than 1/64 inch for size 5/8 inch and under, 1/32 inch for size over 5/8 inch to one inch inclusive, and 3/64 inch for size over one inch.

In determining bolt lengths, the grip shall be calculated the same as for a riveted joint, plus any additional values required by the manufacturer's recommendations. If other than the preferred thickness of washer is used, the necessary length shall be adjusted accordingly. The total length shall be adjusted to the next longer 1/4-inch increment.

Unless otherwise ordered, minimum thread length (extreme point to last complete thread) shall be twice the diameter plus 1/4 inch for lengths up to and including six inches and twice the diameter plus 1/2 inch for lengths over six inches. Bolts too short for the formula length shall be threaded as close to the head as practical.

3. *Nut Dimensions.*—Nut dimensions shall conform to current requirements for Heavy Hexagon Semifinished Nuts of the American Standards Association (A.S.A. Designation B 18.2).

4. *Washer Dimensions.*—Washers shall be flat and smooth, and their dimensions shall be not less than would conform to the current requirements for heavy plain washers (carburized) of the American Standards Association (A.S.A. Designation B 27.2).

Where clearance makes it necessary, washers may be clipped on one side at a point not closer than 7/8 of the bolt diameter from the center of the washer. Where bearing faces of bolted parts are not parallel, beveled washers shall be used to compensate for lack of parallelism.

BOLTED PARTS.

1. *Material.*—This specification contemplates that the bolted parts shall consist of wrought iron, soft steel, or medium steel of a type commonly used in bridges, buildings, and like structures.

2. *Dimensions.*—Surfaces of bolted parts adjacent to bolt head and nut shall be parallel. Bolted parts shall fit solidly together when assembled and without interposition of gaskets or any other flexible material. Holes may be punched, sub-punched and reamed, or drilled, as required by the applicable specifications and shall be of a diameter not more than one-sixteenth inch in excess of the nominal bolt diameter.

3. *Finish.*—The faying surfaces, when assembled, shall be bare, either de-scaled or carrying the normal mill scale. Faying surfaces shall be free of paint, lacquer, dirt, oil, loose scale, burrs, pits, and other defects that would prevent solid seating of the parts or would interfere with the development of friction between the parts.

ASSEMBLY.—Bolts shall be assembled with a hardened washer under the bolt head and nut as described above. All nuts shall be tightened to give the proper bolt tension.

INSPECTION.—The proper execution of the bolting operation shall be checked and approved by a procedure of loosening and retightening a certain proportion of the bolts. The proportion to be thus loosened and re-tightened shall be specified in advance by the Commissioner. The procedure shall be such as to establish that when the nut is re-torqued to its original position, the torque is at least equal to that required.

STRUCTURAL RED LEAD PAINT.

A. *GENERAL REQUIREMENTS.*—This specification covers a paint suitable for use as a primer, spot-coat, or intermediate coat on clean structural steel or over a preceding coat of the same paint.

The Contractor will be permitted to use only those paints which are warranted by the manufacturer to conform to the specifications herein described.

A list of manufacturers who have filed such certificates of warranty may be obtained at the office of the Department.

B. *SPECIFIC REQUIREMENTS.*—Structural Red Lead shall conform to the following specific requirements:

1. *Materials.* — The constituent material comprising the Structural Red Lead Paint shall conform to the Standard Specifications of the A.S.T.M. as indicated:

Red Lead Pigment, 95% Grade	A.S.T.M.	D83
Raw Linseed Oil	A.S.T.M.	D234
Liquid Paint Driers	A.S.T.M.	D600
Turpentine, Gum Spirits of	A.S.T.M.	D13
2. <i>Composition.</i> — Pigment	78%	
Vehicle	22%	
Pigment: Red Lead	100%	
Vehicle: Raw Linseed Oil	90%	
Liquid Drier and Turpentine	10%	

3. *Weight Per Gallon.* — 25.1 lbs. min. net.

4. *Color.* — When applied over a preceding coat of Structural Primer Red Lead, the color of the paint shall be altered by the addition of two (2) ounces of lampblack paste in japan (A.S.T.M. D209) per gallon of paint.

5. *Drying Time.* — The paint shall dry completely and thoroughly in not less than six (6) hours nor more than fourteen (14) hours.

STRUCTURAL INTERMEDIATE COAT (MAROON)

1. *Scope.*—This specification covers a paint suitable for use as an intermediate coat over preceding coats of Structural Red Lead Paint and under finish coat of Structural Chrome Oxide Green Paint, Structural Blue Lead Gray Paint, or Structural Black Paint.

2. *Materials.*—The component ingredients shall comply with the following specifications:

Red Iron Oxide (98%)	A.S.T.M.	D84 Class I
(Gardner-Coleman Oil absorption, 15–25)		

Red Lead (97%)	A.S.T.M. D83
Aluminum Stearate	Distearate type
Linseed Oil	A.S.T.M. D234
Alkyd Resin Solution (70% N.V.)	52R13, Grade II or equal
Liquid Driers	A.S.T.M. D564
Turpentine	A.S.T.M. D13

3. *Composition*.—Pigment 74 per cent.

Red Iron Oxide (98% grade)	50%
Red Lead (97% grade)	50%
0.2% Aluminum Distearate on weight of pigment.	
Vehicle 26% (phthalic anhydride 6% on V.N.V.)	
Raw Linseed Oil	62%
70% Alkyd solution	28%
Turpentine and driers	10%

4. *Weight per Gallon*.—Not less than 21.1 pounds net.

5. *Fineness of Grind*.—Not less than 4 N.S.U.

6. *Consistency*.—80 to 95 K.U. at 25 degrees C.

7. *Drying Time*.—Not less than fourteen (14) nor more than twenty-four (24) hours.

8. *Gloss*.—Low.

9. *Hiding Power*.—Not less than 800 square feet per gallon.

STRUCTURAL BLUE LEAD GRAY PAINT.

A. *GENERAL REQUIREMENTS*.—This specification covers a paint suitable for use over a preceding coat of structural primer or as an intermediate or finish coat, as required.

B. *SPECIFIC REQUIREMENTS*.—Structural Gray Paint shall conform to the following specific requirements:

1. *Materials*. The constituent materials comprising the Structural Gray Paint shall conform to the Standard Specifications of the A.S.M.T. as indicated:

Blue Lead; Basic Sulfate	A.S.T.M. D405
Linseed Oil	A.S.T.M. D234
Liquid Paint Driers	A.S.T.M. D600
Petroleum Spirits	A.S.T.M. D235
Aluminum Stearate	Distearate type

2. *Composition*. — Pigment 75%
Vehicle 25%

Pigment: Blue Lead, Basic Sulfate 99.5%
Aluminum Stearate 0.5%

(Lampblack and/or Iron Blue may be used for tinting)

Vehicle: Linseed Oil 90% min.
Liquid Driers and Thinners 10%

3. *Weight Per Gallon*. — 21.4 lbs. min. net.

4. *Drying Time*. — The paint shall dry completely and thoroughly in not less than six (6) hours nor more than fourteen (14) hours.

5. *Color*. — Successive coats of paint shall be sufficiently tinted to permit visible detection of incomplete application.

All paints and painting materials shall be delivered to the work in the original and unbroken containers plainly marked with the name, brand, and analysis of the product and the name of the manufacturer.

CONSTRUCTION METHODS

SHOP DRAWINGS.—After the contract has been awarded, and before any shop work is commenced, the Contractor shall submit two (2) complete sets of prints of the shop drawings.

The shop drawings shall indicate the surfaces which are not to be painted and the surfaces which are to be treated otherwise than with a shop coat of paint.

DESIGN, FABRICATION AND ERECTION

All structural steel and appurtenant metal shall be designed, fabricated and erected in accordance with the requirements of the A.A.S.H.O. Standard Specifications for Highway Bridges, supplemented by the additional requirements of these specifications.

Unless otherwise noted, dimensions indicated at expansion joints and similar construction are determined for a temperature of 50 degrees Fahrenheit. The proper adjustments for temperature must be made by the Contractor when the structure is placed at any other temperature.

General reaming shall conform to the requirements of the A.A.S.H.O. Specifications.

Arc welding and welding materials shall conform to the current specifications for Welded Highway and Railway Bridges of the American Welding Society. Heavily coated rods shall be used if directed.

All welds shall have the slag removed immediately following a completed pass after which they are to be inspected and checked with a standard fillet gauge. All weld shall be of specified size for the entire length as called for on the plan. Craters are to be filled and fillet welds larger than $\frac{1}{4}$ inch shall be built up with straight multiple pass fillets. Weaving will not be permitted. Each day every weld completed shall be inspected and upon approval shall be thoroughly cleaned and given one coat of Structural Red Lead Paint.

All structural parts shall be provided with adequate drain holes at points where water could otherwise accumulate.

The Contractor may choose his own method of erection, subject to the review and approval by the Commissioner. Before fabrication is begun, the Contractor shall submit the proposed erection procedure to the Commissioner, fully describing temporary structures he plans to use. Only approved procedures may be used.

Permission will be granted to abandon erection bolts in place only when used on the welded diaphragms on the bridges. Permission will be granted on the following conditions: erection bolts shall be used in all holes; the ends of the bolts shall have no excessive projection; a washer shall be placed under each bolt head and nut; only one nut shall be used on each bolt; and, after all welding has been completed, the bolts shall be painted with the same two field coats as is specified for the structural steel. If the erection bolts are not left in place, the erection bolt holes shall be plug welded and ground smooth and flush with the adjoining steel. Either all erection bolt holes shall have bolts in place or all holes shall be plug welded. The two methods shall not be combined.

The Contractor is required to investigate the stresses caused by the erection procedures he proposes to use. Where the Contractor proposed to temporarily strengthen or brace a member, he shall submit for approval by the Commissioner the methods and materials he proposes to use.

The structural steel for the bridge may be used as supports for equipment and erection operations only when it is in its permanent position in the structure. The Contractor shall determine the stresses at each stage, with proper allowances for impact and for wind load on the structure and the equipment. It will not be permitted to produce stresses that will exceed 24,000 pounds per square inch on the net section.

The Contractor shall keep a full record of piles driven for falsework. If the Contractor does not make a pile loading test, the pile bearing formulas of the Standard Specifications shall be used to determine the bearing values.

The steel assembly at expansion joints shall be crowned to the roadway profile, taking skew into consideration. If made up of two or more units, the abutting edges shall be beveled, welded, and

ground smooth. The steel at expansion joints shall be shimmed to provide flush bearing surfaces across the joints without reducing the specified thickness of the concrete slab or the pavement, and without introducing a hump or depression in the roadway.

After erection has been completed, rockers shall be realigned so that they will stand vertical at 50 degrees Fahrenheit under full dead load. Expansion joints shall be centered for 50 degrees Fahrenheit.

PREPARATION OF BRIDGE SEATS. — Masonry bearing plates shall not be placed upon bridge seat bearing areas which are improperly finished, deformed or irregular. Bearing plates shall be set to grade and level in exact position and shall have full and even bearing upon the masonry.

Bearing plates shall be set to grade on sheet lead or on canvas and paint with a full even bearing. The bearing area of concrete shall be poured at least one-quarter inch above the proposed finished grade, and then shall be dressed down sufficiently so that the lead or paint and canvas will bring the area to the correct grade. A $\frac{1}{8}$ -inch sheet of soft lead may be used. If canvas and paint are used, the area shall be thoroughly swabbed with a lead-base paint, and three layers of 12 to 14 ounce duck shall be placed on it, each layer thoroughly swabbed on its top surface with the paint. The paint shall be one of those approved for painting structural steel. The bearing plates shall be placed in position while the paint is plastic.

RIVETING. — Connections shall be accurately and securely fitted up before the rivets are driven.

Rivets shall be heated uniformly to a light cherry red color and shall be driven while hot. Rivets, when heated and ready for driving shall be free from slag, scale, and other adhering material. When driven they shall completely fill the holes. The heads shall be of approved shape, full size, neatly formed, concentric with the shaft, free from fins and in full contact with the surface of the member.

Loose, burned or otherwise defective rivets shall be replaced. In removing rivets, care shall be taken not to injure the adjacent metal and if necessary they shall be drilled out. Caulking or recupping will not be permitted.

Drifting shall be only such as to draw the parts into position and not sufficient to enlarge the holes or distort the metal. If any holes must be enlarged to admit the rivets, they shall be reamed.

Rivets shall be driven with a pneumatic hammer and a pneumatic buckler wherever possible.

The Contractor shall furnish field rivets ten (10) per cent in excess of the number required. This excess shall not be fewer than ten (10) rivets of each size and length.

HIGH TENSILE BOLTS.—When the use of high tensile bolts is specified in the Special Provisions or by written permission from the Commissioner, they will be paid for as rivets driven.

The installation of high tensile bolts shall follow the specification for "Assembly of Structural Joints with High Strength Steel Bolts" as approved February 27, 1954, by the Research Council on Riveted and Bolted Structural Joints (as amended to date). This latter specification is to be followed with the following exceptions:

1. The use of the manual torque wrench or plain wrench shall *not* be permitted for tensioning the bolts.

2. All tensioning shall be performed by the use of pneumatic impact wrenches only, which shall be calibrated to measure directly the tension of the bolt. Impact wrenches shall be of a type, size, model and manufacture as specifically approved in writing by the Commissioner.

3. Pneumatic impact wrenches shall be calibrated every four (4) working hours — usually morning and noon and at such other times as the Commissioner shall deem necessary. Calibrating devices shall be of a type, size, model and manufacture as specifically approved in writing by the Commissioner.

4. All contact surfaces shall be free of paint, scale, burrs, dirt or any other protuberance which would prevent perfect contact — metal to metal — surface. All uneven steel surfaces shall be ground to a true plane prior to "fitting-up" and before any tensioning of the bolts is performed.

5. No welding, burning or other work will be permitted in the area of high strength bolts or washers after they have been placed, in order to prevent any heating of the bolts or washers.

PAINTING.—The surfaces of structural steel which are to be in contact with concrete or gunite shall not be painted.

All other structural steel shall receive three (3) coats of paint as follows: One (1) shop coat of Structural Red Lead Paint, one (1) field coat of Structural Intermediate Paint (Maroon) and one (1) field coat of Structural Blue Lead Gray Paint as directed.

All surfaces of metal shall be thoroughly cleaned of rust, loose mill scale, dirt, oil or grease, and all other foreign substances before applying the shop coat. The removal of rust, scale and dirt shall generally be done by the use of metal brushes, scrapers, chisels, hammers or other effective means. Oil and grease may be removed by the use of gasoline or benzine. Bristle or wood-fibre brushes shall be used for removing loose dust.

In shop-riveted work, all surfaces coming in contact when shop-assembled, shall be painted a good shop coat thoroughly and evenly applied before assembling. These pieces may be assembled while the paint is still wet. The shop coat of paint may be applied with brushes or satisfactory spray machines.

Paint shall not be applied on shop contact surfaces, or on main connections involving multiple thickness of material where a shop coat of paint might introduce difficulties in erection. Field connections not painted in the shop shall receive a shop coat of approved lacquer. Steel that is to be shop welded shall not be painted until welding is completed. Steel that is to be field welded shall be given one coat of boiled linseed oil. Machine finished surfaces, except abutting joints and base plates, shall be coated with a hot mixture of tallow and white lead. Surfaces not in contact but inaccessible after assembly or erection shall be painted in the shop with three coats of Structural Red Lead Paint. Castings shall be given a shop coat of paint. To secure the maximum coating on edges of plates, shapes, rivet heads and other parts subjected to special wear and attack, the edges shall first be striped with a longitudinal motion and the rivet heads with a rotary motion of the brush, followed immediately by the general painting of the whole surface, including the edges and rivets. Where flat sole plates are used, the contact surfaces between the sole plates and the masonry plates shall be coated with powdered graphite, well rubbed in, just before the plates are placed in contact.

When all fabrication work is complete and has been accepted as such, all surfaces not painted before assembling shall be painted a good shop coat. Material shall not be loaded for shipment until thoroughly dry. No painting shall be done after the material has been loaded for transportation.

Erection marks for the field identification of members shall be painted upon previously painted surfaces.

When the erection work is fully completed, including all riveting, bolting, straightening of bent metal, etc., all adhering rust, scale, concrete, laitance, dirt, grease or other foreign matter shall be removed.

As soon as the field cleaning is done to the satisfaction of the Commissioner, the first field coat shall be applied. In order to avoid subsequent discoloring or staining due to drippage or running of concrete, field painting of structural steel shall not be done until concrete nearby has been placed and all forms have been removed.

In no case shall a succeeding coat be applied until the previous coat has dried throughout the full thickness of the paint film. No paint shall be applied in less than five (5) days after the preceding coat except by permission of the Commissioner in writing.

All small cracks and cavities which have not been sealed in a water-tight manner by the first field coat shall be filled with a pasty mixture of red lead and linseed oil before the second field coat is applied.

Paint shall be applied only when the air temperature is at or above 50 degrees F. It shall not be applied upon damp surfaces or upon metal containing frost, nor shall it be applied when the air is misty, or otherwise in the opinion of the Commissioner, unsatisfactory for the work.

All paint shall be applied by hand in a smooth, even coat, thoroughly spread and worked in with brushes, except as otherwise specified. Round or oval brushes shall preferably be used; if flat brushes are permitted they shall be not over four inches wide.

The paint when applied shall be so manipulated under the brush as to produce a uniform, even coating in close contact with the metal or with previously applied paint. In general, the primary

movement of the brush shall describe a series of small circles to fill thoroughly all irregularities in the surface, after which the coating shall be smoothed and thinned by a series of parallel strokes. All painting shall be done in a neat and workmanlike manner. On all surfaces which are inaccessible for paint brushes, the paint shall be applied with sheepskin daubers specially constructed for the purpose. All metal coated with impure or unauthorized paint shall be thoroughly cleaned and repainted to the satisfaction of the Commissioner, at the expense of the Contractor.

Paint spraying machines may be used only with the special consent of the Commissioner. The right is reserved to require the use of brushes for paint application, should the work done by such machines prove unsatisfactory in the opinion of the Commissioner.

If directed, the Contractor shall supply a mechanical paint mixer on the job and such mechanical mixer shall be operated in the original paint containers a sufficient length of time, prior to drawing off paint into the painter's buckets, to mix the pigment and vehicle thoroughly. Paint shall be kept thoroughly stirred during application.

Paint may be thinned only upon the express direction of or with the permission of the Commissioner to adjust viscosity for temperature changes.

The date (year and month) of painting and the bridge number shall be stenciled on the bridge as directed by the Commissioner. The stencils shall be furnished by the Contractor at his own expense.

The Contractor shall protect all parts of the structure against disfigurement by spatters, splashes and smirches of paint or of paint materials.

MEASUREMENT AND PAYMENT

Payment will be based on computed weights of steel complete in place in the structure. No additional allowance in weight will be made for the shop coat of paint or for any other coats of paint or other protective covering.

The weights of rolled shapes and of plates, regardless of the width of the plates, shall be computed on the basis of their nominal weights and of their dimensions as shown on the approved shop drawings, deducting for copes and cuts, and for all open holes (including holes for field plug welds), except holes that are to be filled with rivets or bolts.

Steel for expansion assemblies at the roadway level of bridges and similar structures (whether or not attached to the structural steel of the deck) and bronze or other metal for expansion bearings will be included in the weight to be paid for as structural steel unless specifically noted in the Special Provisions as being a separate Item. Where no separate Item is in the contract for galvanized nose angles on the piers, these angles will be paid for by the pound as structural steel, with no additional compensation for the galvanizing.

Computed weights shall not include the weights of welds.

The weights of the various metals shall be assumed as follows:

Steel (Structural, Cast, Galvanized)	490 lbs. per cubic foot
Cast Iron	450 lbs. per cubic foot
Wrought Iron	485 lbs. per cubic foot
Phosphor Bronze	542 lbs. per cubic foot

The weight of heads of rivets shall be added to the computed weights, assuming the weights to be as follows:

Diameter of rivet, inches	Weight per 100 heads, pounds
1/2	4
5/8	7
3/4	12
7/8	18
1	26
1 1/8	36
1 1/4	48

Payment of rivet heads will be made by the pound. Where ribbed bolts or high tensile steel bolts are used in the permanent construction, the nuts and heads of these bolts shall be considered, for the purpose of payment, as rivet heads for rivets equal in diameter to the bolts, regardless of the material of which they are composed or the materials which they fasten. All permanent washers will be paid for by the pound. The shank of a bolt will be considered as part of the material through which it passes and will be paid for as part of that material. No allowance of payment will be made for that part of a bolt shank that extends through and past the nut.

The furnishing, fabricating, erecting and painting of all structural steel and all metal work for the structure not otherwise provided for, will be paid for at the contract unit price per pound under the Item for Structural Steel, complete in place, which price shall include full compensation for all materials, paint, painting, transportation, falsework, labor, tools, equipment and other incidental work. This price shall also include full compensation for the preparation of bridge seats, the setting of anchor bolts and masonry base plates and the furnishing and placing of all gaskets, oil, grease, or similar material required for expansion bearings.

Partial payments may be allowed at the discretion of the Commissioner for structural steel fabricated and delivered on the site of the work, but not erected. The balance due will be paid when the steel is erected, complete in place.

To avoid delay in computation of the weight for partial and final payment, the Contractor shall submit his computation for the steel shown on each of the approved shop drawings as soon as practicable after the sheet has been approved. The computation by the Contractor shall show the weight for each member, except that duplicate members may be grouped together.

PAYMENT ITEM

F5-1 — Structural Steel.....Pounds

SECTION F-6

STEEL REPAIRS TO EXISTING STRUCTURES

GENERAL

The work to be done under this Section shall consist of furnishing, fabricating, erecting and repairing structural steel including cutting, welding, burning, drilling, reaming, bolting, riveting and all appurtenant work required to make repairs to existing structures as shown on plans or specified.

This work may also include furnishing, installing, repairing, storing and replacing fixed and expansion bearing plates, expansion joints, hand rails, guard rails, fences, gates, and all other metal work related to the repair of existing structures.

Work in connection with general repairs such as removing wearing surface and underdeck materials, drainage facilities, pipe and conduit work, redecking, concrete, guniting, masonry work, and cleaning and painting shall be performed in accordance with, and paid for under the respective Sections and Items covering such work or portions thereof.

MATERIALS

STEEL.— Structural Steel, Wrought Iron, Bearing Plates, Castings, Paint and all other materials required under the Item of steel repairs shall conform to all the applicable requirements of these Standard Specifications, in general, and to Section F-5 in particular.

DRAWINGS.— After the contract has been awarded, and before any shop work is commenced, the Contractor shall submit two (2) complete sets of prints of the shop drawings.

The Contractor shall prepare whatever further detail drawings are needed to carry out the work and shall submit them to the Commissioner for his approval before beginning work under the same. There shall be no changes made on such plans after approval except with the written consent of the Commissioner. Copies of all shop drawings and shop lists made for the work shall be filed with the Commissioner for reference, before shipment of the work. The Contractor shall furnish as many additional copies and prints as are needed for the supervision of the work and for record.

Where piece marks are shown on the plans, the same are to be clearly marked on all the corresponding pieces and members of the work.

At completion of the work, the Contractor shall furnish the Commissioner with one complete, corrected set of all plans in ink on tracing cloth of the same size as the original contract drawings, with margins and titles conforming thereto.

FABRICATION, ERECTION AND REPAIRING.—All new structural steel and appurtenant metal shall be fabricated and erected as set forth in Section F-5 conforming with the construction methods, quality of materials and standards as set forth therein, as hereinafter specified, and as required by the Special Provisions. The performance of all other elements of repair work shall conform with the requirements of the respective Sections and Items contained elsewhere in these Standard Specifications.

In general, throughout the entire structure, all steelwork shall be checked for general condition and the Contractor shall make such repairs or renewals as may be required in the opinion of the Commissioner.

The Contractor shall notify the Commissioner when he intends to commence any required jacking operations such as may be necessitated by the removing of old roller nests and replacing with new expansion bearing plates.

Repair, replacement and the application of protective coating for the substructure, supporting steelwork, bearings and underdecking shall be completed and inspected by the Commissioner before work is commenced on new decking.

CUTTING-OUT RIVETS.— In removing rivets, the surrounding metal shall not be injured; if necessary, they shall be drilled out. Burning out of rivets will not be permitted.

DRIVING NEW RIVETS OR BOLTS.— In all cases where new rivets cannot be satisfactorily driven, or where the Commissioner may direct, ribbed bolts with self-locking units or high tensile steel bolts with nuts and washers conforming to the requirements of Section F-5, shall be used.

Wherever bolts are to be used, the holes shall be reamed, if required, after the parts are assembled in the structure in final position and the bolts turned to a driving fit. Where required or directed by the Commissioner, the heads of such bolts shall be tack welded to the steel to prevent turning of bolt when the nut is being tightened. Unless otherwise permitted, all bolts shall have hexagonal heads and nuts, threads to be United States Standard.

WELDING.—All welding shall conform to the specifications of Section F-5, and the following:

A. Rivet heads to be built up by welding shall be built up to their original size, the new material to form a solid thickness of head, fully engaging all of the old rivet material.

B. Plug welds shall completely fill the holes and shall be flush with the outside face of plates, angles, etc., unless otherwise directed by the Commissioner or specified. Each hole so filled will be considered one (1) plug weld regardless of size or depth.

C. All other field welding shall be $\frac{3}{8}$ -inch fillet welds unless otherwise shown or directed. All welding shall be done by experienced men using the direct current electric arc process, in accordance with the specifications of the American Welding Society and the requirements hereinbefore set forth under Section F-5, in so far as they may apply to the work under the contract. Only shielded arc rods shall be used.

MEASUREMENT AND PAYMENT

Payment for all new structural steel, except field rivets and field welding, furnished and placed permanently in the new work for repairing or altering the existing steelwork will be based on computed weights of steel and the price bid shall include all costs for shop fabrication, shop welding and the shop coat of paint; for removing and disposing of old steel where required; for furnishing, placing, maintaining and removing such temporary bracing, shoring, supports, and jacking operations; removing and transporting sections for shopwork and all appurtenant work not specifically covered by other items.

The weights of rolled shapes and plates, regardless of the width of the plates, shall be computed on the basis of their nominal weights and of their dimensions as shown on the approved shop drawings, deducting for copes, cuts and all open holes (including holes for field plug welds), except holes that are to be filled with rivets or bolts.

The weights of the various metals shall be as specified under the Item for Structural Steel, Section F-5.

The weights of heads of shop rivets shall be added to the computed weights, assuming the weights to be as specified under the Item for Structural Steel.

Rivets cut out, new holes drilled, new rivets or bolts driven, existing rivet heads built, and plug welds (regardless of size or depth) all done in the field will be counted each as one contract unit.

Fillet welds in the field, will be measured by the lineal foot.

All other Items in the Proposal will be measured as stated in the particular sections applying to the Items.

If required by the Commissioner, the computation of pay weights will be based on scale weights, in which case the pay quantity of structural steel will be the shop scale weight of the fabricated members, which shall be weighed on satisfactory scales in the presence of the Department's authorized representative or a representative of an agency designated by the Commissioner. If the shop paint has been applied to the completed member when weighed, 0.4 of one per cent of the weight of the member shall be deducted from the scale weights to compensate for the weight of shop paint. Payment will not be made for any weight in excess of one and one half per cent above the computed net weight of the whole Item.

A shipping slip showing size, number of pieces and weight of each piece shall be delivered to the inspector at the job site with each delivery of steel.

The furnishing, fabricating, erecting and shop painting of all structural steel and all metal work for the structure not otherwise provided for, will be paid for at the contract unit price per pound under the Item for Steel Repairs to Existing Structures, complete in place, which price shall include full compensation for all materials, shop paint, transportation, falsework, labor, tools, equipment and other incidental work. This price will include miscellaneous steel, iron and other metals and materials appurtenant to the work, unless specified otherwise in the Special Provisions.

Partial payments may be allowed at the discretion of the Commissioner for structural steel fabricated and delivered on the site of the work, but not erected. The balance due will be paid when the steel is erected, complete in place.

To avoid delay in computation of the weight for partial and final payment, the Contractor shall submit his computations for the steel shown on each of the approved shop drawings as soon as practicable after the sheet has been approved. The computation by the Contractor shall show the weight for each member except that duplicate members may be grouped together.

PAYMENT ITEMS

F6-1 — Structural Steel for Repairs.....	Pounds
F6-2 — Defective Rivets Cut Out.....	Each
F6-3 — New Field Holes Drilled.....	Each
F6-4 — New Field Rivets Driven.....	Each
F6-5 — Rivet Heads Built Up.....	Each
F6-6 — Field Plug Welds.....	Each
F6-7 — Field Fillet Welding.....	Lineal Foot

SECTION F-7

STEEL GRID FLOOR

GENERAL

This item consists of furnishing and placing steel grid floor, complete in place, with end trim and fully spliced; designed, fabricated and installed in accordance with the Standard Specifications of the A.A.S.H.O.

MATERIALS

All steel shall conform to the Specifications for Steel for Bridges and Buildings of the A.S.T.M., A-7.

Materials, tolerances, assembly and sizes of members shall conform to the published specifications of the manufacturer of the type accepted by the Commissioner.

If required in the Special Provisions, the grid flooring shall be galvanized with 2.00 ounces per square foot of surface in conformity with the requirements of the A.S.T.M. Serial Designation A-153. Galvanizing shall be done after all shop fabrication work has been completed.

Otherwise, units shall be furnished at the site with one dip coat of priming paint applied at the shop and when complete in place, with one field coat of Structural Red Lead and two coats of Structural Blue Lead Gray paint; quality of material and workmanship to be as specified under Section F-7. The final coat of paint shall be sufficiently tinted to permit visible detection of incomplete application.

DESIGN. — Sizes, design and pattern of the steel grid floor shall be as noted in the Special Provisions and in accordance with the details shown on plan. The Commissioner reserves the right to select any one of the acceptable grating manufacturers whose product gives satisfactory evidence as to being durable, anti-skid, capable of carrying the specified loads at unit stresses within the limits set by the specifications, and of such weight as to best suit the bridge for which it is intended.

The grid flooring shall be furnished in units fabricated in such a manner as to permit end and side splicing on the job, so as to form one continuous pavement free from joints and of uniform pattern, continuous in all directions except where provisions must be made for expansion joints, or other interferences.

The grid shall be at least 80 per cent open, with each mesh unit providing at least two (2) square inches of steel surface for wheel contact. All top edges of the grid shall be flush, presenting a smooth even surface for traffic.

Carrying bars of the grid, spaced two and one half inches on centers, shall be laid longitudinal with the roadway and shall be riveted to shallower crimped bracing bars throughout the entire deck with three-eighths-inch cold driven rivets on five-inch centers.

CONSTRUCTION METHODS

Before fabrication or construction, the Contractor shall submit two (2) complete sets of shop and assembly drawings for the Commissioner's written approval.

The floor shall be connected to its steel supports with every bearing bar welded to every sill or support with fillet welds extending the full length of bearing. Field splices shall be made in accordance with the manufacturer's published specifications.

Steel grid to be filled with concrete shall be left unpainted and kept free from foreign substances which might tend to prevent bond with the concrete. Suitable metal form strips shall be furnished and installed in accordance with the steel grating manufacturer's recommendations to retain the concrete without leakage until thoroughly set.

Concrete for steel grid filler shall conform to all the applicable requirements for concrete as set forth hereinbefore for concrete, except that the composition shall be Class Y of the A.A.S.H.O., proportioned by weight in the ratio of approximately 1 : 2 : 2.5 and containing rounded gravel coarse aggregate, uniformly graded from one half inch to No. 4, 100 per cent passing the one-half-inch sieve, and such other gradation as to be best suited for producing a compressive strength of 3,000 pounds per square inch, smooth finish, and of special workability for steel grid floor filler.

MEASUREMENT AND PAYMENT

Payment for steel grid floor, open or concrete filled, shall include the furnishing of all materials, equipment, tools, and labor necessary for the satisfactory completion of the work. Payment will be made at the respective contract unit prices per square foot of steel grid floor, open or concrete filled, complete in place, unless otherwise specified.

PAYMENT ITEMS

F7-1 — Open Steel Grid Floor	Square Feet
F7-2 — Concrete Filled Steel Grid Floor	Square Feet

SECTION F-8

STEEL BEAM HIGHWAY GUARD

GENERAL

Steel beam highway guard shall consist of pressed steel plates suitably attached to steel posts. It shall be erected as shown on the plans and where directed by the Commissioner and in accordance with these specifications.

MATERIALS

FABRICATION. — All metal work shall be fabricated in the shop. No punching, cutting or welding shall be done in the field. Holes for special details in exceptional cases may be made in the field when approved but such holes shall be drilled. Field punching may be permitted, if approved by the Commissioner, after it has been demonstrated that such punching will not result in damage to the surrounding metal.

After fabrication, certain elements shall be painted before shipment as specified herein.

STEEL POSTS. — Steel posts shall be fabricated from new structural steel "H" or "Z" sections conforming to the dimensions and design shown on the plan. "Z" sections shall weigh approximately eight and one-half pounds per foot. Structural steel shall conform to the requirements of A.S.T.M. Designation A7, and shall be fabricated in accordance with the requirements of the current edition of the A.A.S.H.O. Standard Specifications for Highway Bridges.

The rail element or beam shall be made of open-hearth or electric furnace steel plates which shall have the following chemical composition:

Carbon	0.30% to 0.75%
Manganese	0.60% to 1.20%
Phosphorus, Maximum	0.04%
Sulphur, Maximum	0.05%

A test specimen shall elongate not less than 12 per cent in a two-inch gauge length when tested in accordance with Designation E8 of the A.S.T.M.

Each end of the rail for every stretch of guard shall be fitted with an end section so formed that its end shall be at least seven inches back of the face of the rail and shall extend at least 18 inches beyond the center of the end post. The end section shall have the same splice detail as the rail.

The edges of the rail shall be rolled or rounded so that they present no sharp edges. The projecting heads of all connection and splice bolts shall be rounded and shallow so that no appreciable projection will obstruct a vehicle sliding along the rail.

The Contractor's attention is specifically directed to the fact that when this type of highway guard is to be used on curves having such radii that straight lengths of the rail will not conform to the required line, the rail element shall be pre-curved in the shop to fit the specified radius. The Contractor shall inform himself of the particular manufacturer's requirements relative to constructing beam type highway guard on curves.

The Highway Guard shall be New Standard Heavy Duty Steel Beam Type, (ten gauge) and the rail element including splices for this type of guard shall have an ultimate tensile strength of at least 70,000 pounds. It shall have a section modulus greater than 1.35 inches cubed, based on full section. A length of rail freely supported at each end on 12-foot centers shall have a maximum deflection of three inches under a 2,000-pound concentrated load applied at the middle of the span.

FITTINGS.— No offset brackets will be required for beams with a depth of three inches or more. However, if the edges of such beams do not make contact with the posts the beams shall be horizontally supported by metal offset brackets which may or may not be resilient.

Beams with a depth of less than three inches shall be supported five to seven inches from the face of the posts with spring-like brackets which shall deflect at least one inch under compression perpendicular to the line of the rail of 3,500 pounds and shall not completely flatten out or break under compression of 6,000 pounds.

The bracket and connection to the post combined shall be capable of supporting a load of 2,300 pounds at the rail and parallel to the rail.

Bolts and nuts shall be of wrought iron conforming to the A.S.T.M. Designation A-41 or of structural steel conforming to the A.S.T.M. Designation A-7. Washers may be of malleable iron, cast iron, or cut steel. All hardware shall be galvanized by the hot-dip method, except that washers may be either galvanized or painted.

Asphalt varnish shall conform to the requirements of Federal Specification TTV-51a(1) and shall be of such quantity as to give a tough flexible film, free from tackiness, and which will not chip off or flake off in handling.

Zinc sulphate solution shall be made in the proportion of eight pounds of zinc sulphate (technical crystals) to one gallon of water.

GUARD RAIL PAINT.—Guard rail white paint shall conform to the requirements of the Massachusetts Department Specification No. P-340-49.

Guard rail black paint shall be an asphalt varnish conforming to Federal Specification TTV-51a(1), and shall be of such quality as to give a tough flexible film, free from tackiness, and which will not chip off or flake off in handling.

SYNTHETIC PRIMER.—The component ingredients for synthetic primer shall conform to the current specifications of the A.S.T.M. wherever applicable, and as follows:

Pigment	42-44%
Zinc Chromate	55% Minimum
Iron Oxide and Silicates	45% Maximum
Vehicle	56-58%
Raw Linseed Oil plus Phenolic Spar Varnish (non-volatile solids)	55% Minimum
Thinner and Drier	45% Maximum

CONSTRUCTION METHODS

ERECTION.—Posts shall be set plumb, true to line and grade as shown on the plans and as directed. Unless otherwise specified, they shall be spaced $12\frac{1}{2}$ feet on centers as measured along the center line of the rail. They shall be set three and one-half feet into the ground. The post holes shall be backfilled with suitable material, thoroughly tamped, or set in concrete when so specified in the Special Provisions.

Steel posts may be driven provided suitable driving caps and equipment are used to prevent injury. Before driving, the earth at the post location shall be removed to a depth of about eight inches below the finished grade and about 12 inches in diameter. The posts shall be driven to the required depth and varnished as hereinafter specified. After the varnish has become thoroughly dry, suitable material shall be placed in the space around the posts and thoroughly tamped.

For bridge installations, the Highway Guard shall be assembled, erected and secured in accordance with the manufacturer's typical details and as shown on the plans.

The rail shall be so erected as to form a smooth continuous rail conforming to the required line and grade. The rail element shall be spliced at each post by lapping in the direction of traffic or shall be erected by other approved methods. The holes in the rail element nearer the post shall be slotted to facilitate erection and to permit expansion. The rail shall make full contact at each splice and the bolts at expansion joints shall be located at the center of the slotted holes.

All bolts, except where otherwise required at expansion joints, shall be drawn tight. Bolts through expansion joints shall be drawn up as tight as possible without being too tight to prevent the rail

elements from sliding past one another longitudinally. Bolts shall be sufficiently long to extend at least $\frac{1}{4}$ inch beyond the nuts. Except where required for adjustments, bolts shall not extend more than one half inch beyond the nuts.

PAINTING AND VARNISHING.— After fabrication and before shipment, the steel posts, rail element and offset brackets shall be cleaned to a steely brightness by scrapers and wire brushes or by sand-blasting, if necessary, and painted with one shop coat of any one of the following primers: Structural Red Lead Paint, Structural Blue Lead Gray Paint or Synthetic Primer. If washers are not galvanized they shall be painted before shipment in the manner specified herein.

After erection, all steel posts shall be varnished below the elevation of the bottom of the rail element to an elevation six inches below the finished ground level (or to the bottom of the post, for bridge installations) with one coat of asphalt varnish which shall be free of pinholes, cracks or other defects.

All posts shall be painted with two coats of guard rail white paint from the elevation of the bottom of the rail element to the top of the post.

After the highway guard has been erected as specified, the steel rail and bracket assembly shall be painted with one field coat of either Structural Red Lead Paint or Structural Blue Lead Gray Paint. All exposed surfaces shall then be painted with two coats of Guard Rail White Paint, except that the posts shall be painted as specified above. Contact surfaces shall be painted prior to erection.

MEASUREMENT AND PAYMENT

The length of highway guard to be paid for shall be the actual length of steel beam rail when installed in place, as measured along the top edge of the rail element.

The highway guard will be paid for at the contract unit price per lineal foot, complete in place, which price shall constitute full compensation for all materials, tools, labor and excavation (except rock), bending the rail element as necessary to fit curves, and all other incidental work necessary to complete the Item as specified.

Allowance for rock, if not already paid for under previous rock excavation, shall be made for a distance of 12 inches outside of the post and shall be included in the Item for rock excavation.

PAYMENT ITEM

F8-1 — Steel Beam Highway Guard Lineal Feet

SECTION F-9

MEMBRANE WATERPROOFING

GENERAL

Membrane waterproofing applied to the surfaces indicated on the plan and wherever else directed shall consist of either (a) an asphalt primer and a three-ply membrane of asphalt-saturated fabric mopped with asphalt, or (b) a creosote primer with a three-ply membrane of tar-saturated fabric mopped with tar pitch.

MATERIALS

ASPHALT.

A. ASPHALT PRIMER. — Asphalt primer shall conform to the requirements of Designation D-41 of the A.S.T.M.

B. PLYING AND MOPPING ASPHALT. — Asphalt used for fabric saturant and for mopping shall conform to the requirements of Designation M-115 Type A of the A.A.S.H.O.

CREOSOTE PRIMER. — The creosote primer for use with coal tar pitch shall conform to the requirements of Designation D-43 of the A.S.T.M. The consistency of the distillation residue above 355 degrees Centigrade shall be soft at 25 degrees Centigrade.

SATURATED FABRIC. — The fabric used in the membrane system of waterproofing shall be one of the following 3 kinds, at the option of the Contractor.

- (a) Woven cotton, conforming to requirements of Designation M11-7-54 of the A.A.S.H.O.
- (b) Woven burlap, conforming to the requirements of Designation D1327-54T of the A.S.T.M.
- (c) Woven glass, an open mesh smoothly woven cloth made from inorganic glass fibres, conforming to the following:

The glass fibres shall be acid resisting, shall not rot nor decay, and shall show minimum capillary and wicking action.

The cloth shall have a uniform coating compatible with asphalt base or coal tar base compound, as specified.

Weight per square yard of the coated fabric shall be not less than 1.5 ounces nor more than 2.6 ounces.

The weight of the moisture free uncoated cloth per square yard shall be not less than 1.2 ounces nor more than 2.0 ounces.

The thread count per inch in either the direction of the wrap or of the filling shall be not less than 20 nor more than 24. The cloth may have 10 double strength threads in the filling provided it passes the Breaking Strength Test.

When tested without the use of masking tape by the grab method, A.S.T.M. Designation D39, the breaking strength of the coated cloth in either the direction of the wrap or of the filling shall be not less than 75 pounds.

COPPER FOR FLASHINGS. — Copper shall be 16-ounce sheet copper and shall conform to the requirements of Designation B-152 of the A.S.T.M.

PLASTIC CEMENT. — Plastic cement shall be composed of semi-solid asphalt dissolved in a suitable volatile solvent and stiffened with a mineral filler consisting essentially of short fiber asbestos.

A. ASPHALT BASE. — The asphalt forming the base of plastic cement shall be either a fluxed native asphalt or a straight steam-refined asphaltic petroleum residual that has not been oxidized or blown, the pure bitumen of which shall meet the following minimum requirements:

Penetration at 77° F., 100 gms. 5 sec.	30
Ductility at 77° F., 5 c.m. per min.	100 c.m.

It shall be free from water, oxidized petroleum, residuals from the cracking process, sludge asphalt, tar or pitch products, or derivatives thereof.

B. COMPOSITION. — Plastic cement shall meet the following requirements:

	By Weight
Fluxed Native or Steam-refined Petroleum Asphalt, not less than	38 per cent
Short Fiber Asbestos, not less than	25 per cent
Petroleum Solvent, not more than	25 per cent

C. TESTS.

1. Plastic cement shall be of such consistency that it can be spread readily with a trowel without drawing or pulling, or can be extruded through a suitable nozzle under a pressure of 50 pounds or more per square inch.

2. When applied in a layer $1/16$ to $1/8$ inch thick, plastic cement shall set within 24 hours to a tough plastic coating, free from blisters.

3. After drying for 72 hours, a patch of plastic cement $1/16$ to $1/8$ inch thick, applied to the material upon which it is to be used, shall not blister or sag more than $1/4$ inch upon exposure at a temperature of 140 degrees Fahrenheit, for five hours.

4. After drying for 72 hours, and exposure at a temperature of 140 degrees Fahrenheit for five hours, a patch of the cement $1/16$ to $1/8$ inch thick shall be plastic and adhere well to saturated fabric, saturated felt, metal or concrete, upon exposure at a temperature of 32 degrees Fahrenheit for one hour.

5. After drying for 24 hours, and exposure at a temperature of 140 degrees Fahrenheit for 24 hours, and then cooling to a temperature of 70 degrees to 77 degrees Fahrenheit, a patch of cement $1/16$ to $1/8$ inch thick shall not crack or break from the saturated fabric, saturated felt or metal, when bent over a mandrel one inch in diameter.

CONSTRUCTION METHODS

PREPARATION OF SURFACE. — All concrete surfaces which are to be waterproofed shall be screeded to the true cross section. Depressions shall be slushed with 1:2 mortar to make a flush surface. The primer shall be applied only after the mortar has completely set. Other surfaces shall be trimmed free of projections or other defects that might cause puncture of the membrane. The surface shall be dry, so as to prevent the formation of steam when the hot asphalt or tar is applied. Immediately before the application of the waterproofing, the surface shall be thoroughly cleaned of dust and loose materials.

No waterproofing shall be done in wet weather, nor when the temperature is below 35 degrees Fahrenheit, without special written permission of the Commissioner. Should the surface of the concrete become temporarily damp, it shall be covered with a 2-inch layer of hot sand which shall be allowed to remain in place from one to two hours, or long enough to produce a warm and surface-dry condition, after which the sand shall be swept back, uncovering sufficient surface to begin the work.

This operation shall be repeated whenever found necessary as the work progresses.

APPLICATION.

A. PRIMER.—The primer shall be applied in one coat on the even, dry surface of the concrete or steel prior to the first mopping coat, except where an extra ply of saturated fabric is to be used at expansion joints. The priming coat shall be applied approximately 24 hours before the waterproofing membrane is laid and shall be dry before the first mopping is applied.

B. SATURATED FABRIC. — After the priming coat has been allowed to dry, there shall be applied an even coat of mopping material which shall be either asphalt heated in suitable boilers to a temperature of 375 degrees Fahrenheit, or tar pitch heated to 200 degrees to 250 degrees Fahrenheit depending on which design is being constructed. Heating kettles shall be equipped with thermometers. While the mopping material is still hot, the first ply of saturated fabric shall be laid with edges lapped three inches and free from folds and pockets. The surface of the saturated fabric shall then be heavily coated with the mopping material and while the material is still hot, a second ply of saturated fabric

shall be laid in the same manner with edges lapped three inches and breaking joints with the first ply of saturated fabric already in place. A third ply of saturated fabric shall be laid in the same manner as the first and second plies, thus making a 3-ply membrane, all thoroughly saturated, cemented and bonded together and to the concrete with mopping material. The top surface of the final ply of fabric shall be given a heavy coat of mopping material. The amount of bitumen used for each mopping shall be not less than $4\frac{1}{2}$ gallons for each 100 square feet of surface.

Placing of waterproofing shall begin at the lower end of the structure and shall then be progressively placed towards the higher part of the structure, so that any water that penetrates to the surface of the membrane will run over the laps rather than against the laps.

Where granite curb is to be placed at the edges of the surface to be waterproofed, the membrane shall extend about three inches beyond the back of the curb and shall be turned up in back of the curb after the curb has been placed. The same requirements shall apply when granite edging is used.

Where the membrane waterproofing will be placed at steel expansion joints, scuppers, manholes, or other metal projecting through the concrete, the membrane shall be turned up about one inch as a seal at the metal. Plastic cement shall be placed to furnish fillers and supporting fillets at the points where the membrane is to be turned up.

JOINTS. — All joints in the concrete flooring, whether paper joints between cracks, joints provided where concrete work is temporarily left off or where clearly defined cracks are liable to appear in the concrete shall be treated as follows:

Joints shall be filled with plastic cement conforming to the requirements set forth hereinbefore. Joints shall be dry and clean immediately before they are filled. They shall be overfilled slightly to allow for shrinkage in drying.

After the priming coat has been applied, and before the surface of the concrete bridge floor has received the first coat of bitumen for mopping, one extra ply of saturated fabric for a width of not less than nine inches each side of the joint shall be laid over all joints in the concrete floor and the 3-ply membrane mopped on top of the extra ply of saturated fabric, but the under side of the extra ply shall remain loose. This is in order to distribute throughout the entire width of the extra ply any movement which might occur in the joints.

The construction of the protection course or roadway surfacing shall follow the waterproofing so closely that the latter will not be exposed without protection for more than 24 hours.

Flashings shall be placed as indicated on the plan. If not otherwise specified, the flashings shall be sheet copper as specified.

MEASUREMENT AND PAYMENT

Membrane waterproofing will be measured by the square yard and the quantity to be paid for shall be the number of square yards of surface covered by the three plies of fabric, with no allowance for overlapping or for edges turned up for seals or carried into recesses of seals.

The membrane waterproofing will be paid for at the contract unit price per square yard under the Item for Membrane Waterproofing, complete in place, which price shall include full compensation for all materials, labor, equipment and tools used to do the work as specified.

PAYMENT ITEM

F9-1 — Membrane Waterproofing.....Square Yards

SECTION F-10

TIMBER STRUCTURES AND LUMBER WORK

GENERAL

The work to be done under this Section shall consist of furnishing all treated or untreated lumber, hardware, and the fabrication and erection of all temporary or permanent structures in accordance with these Specifications, as shown on the plans and as required by the Special Provisions.

The work may include bridge deck work, pile foundation and fender pier construction and repair, such as pulling old piles, spurs and stubs; placing new intermediate low caps and bracing; replacing girder caps, bracing, posts, and piles; refastening existing pile work, redriving old piles as spurs; removing old lumber; and such other appurtenant work and materials as may be specified, required or directed.

MATERIALS

Lumber shall conform to the requirements of A.S.T.M. Designation D-245 applying to all Stress-Grades and as hereinafter specified.

The kind of lumber to be used will depend upon design stresses, usage and the particular preservative treatment specified. When the retention of preservative is specified to be 16 pounds or more of creosote per cubic foot of wood, either Southern Yellow Pine lumber or Douglas fir (coast region) shall be used. When salts, chromated zinc chloride, zinc chloride, or zinc meta-arsenite is specified as the preservative, the lumber shall be either Douglas Fir (coast region) or Yellow Pine.

All lumber used shall be sound, well seasoned and straight grained, out of wind, free from shakes and large or loose knots and shall have no decayed wood, worm holes or any defects which, in the opinion of the Commissioner, will impair its strength or durability for the purpose intended. Pieces of exceptionally light weight will not be accepted.

Each piece of lumber or timber unless otherwise specified shall bear the official grade-mark and trade-mark of the association under whose rules it is graded and the identification mark or number of the mill that manufactured it.

The Contractor shall notify the Commissioner as to the source of supply of the lumber as soon as possible after it has been determined. If no arrangement is made by the Commissioner for inspection under the Commissioner's supervision, the Contractor shall furnish to the Department, for approval, five certified copies of the grading, made in accordance with the rules of the West Coast Bureau of Lumber Grade and Inspection for Douglas Fir, the rules of the Southern Pine Inspection Bureau in the case of Southern Pine, and for other species, in accordance with the grading rules adopted by a lumber grading or inspection bureau or agency recognized by the City as being competent, and which conform to the basic provisions of the "American Lumber Standards."

In the event that the obtaining of grade marking or inspection certificate issued by the association is impracticable, then the material shall be graded by an inspection agency recognized by the City as being competent, under the latest rules of the applicable association and a certificate issued by said agency shall accompany deliveries.

Unless otherwise specified on the plans or in the Special Provisions, the stress grade, species and extent of dressing of all lumber shall conform to the Lumber Grade Use Guide of the National Lumber Manufacturer's Association for the particular structural purpose intended.

PRESERVATIVES.— Timber preservatives shall conform to the requirements of the current standard specifications for creosote and salt preservatives of the American Wood Preservers' Association. The particular type or types of preservative to be furnished shall be as specified in the Special Provisions or as noted on the plans. Grade 1 creosote oil shall be furnished when creosote is specified as a preservative. (A.S.T.M. Serial Designation, D-390.)

The Contractor shall notify the Commissioner of the name and location of the treating plant or plants as soon as the Contractor has placed his order for treating lumber. If the Commissioner does not arrange for inspection the Contractor will be required to furnish to the Department, for approval, five copies of a certificate from the treating plant or plants stating that the methods of treatment conform to the requirement specified, and five copies of a certificate giving the chemical analysis of the preservatives. These certificates shall be furnished before any material is placed. Furnishing of the certificates by the Contractor shall not act as a bar to rejection of any materials by the Commissioner if he finds that they do not meet the requirements. Any cost involved in furnishing the certificates shall be borne by the Contractor.

FASTENINGS.—All fastenings shall be genuine wrought iron or best quality steel. Steel fastenings shall be galvanized by the hot dip method and shall have a continuous coating of pure zinc of uniform thickness weighing not less than two (2) ounces per square foot. Bolts used to fasten wood to wood shall have square heads and nuts. Washers may be cast O-gee or malleable castings, or they may be cut from medium steel or wrought iron plate as indicated, but in general, they shall be not less than $\frac{1}{4}$ inch thick and of the same material as the bolts. Nails shall be cut or round wire of standard form; spikes shall be cut or wire spikes, or boat spikes. The plans or Special Provisions may require that nails or spikes be barbed, cement-coated or otherwise specially treated and designed to best suit the work to be done.

CONSTRUCTION METHODS

HOLES FOR BOLTS, DOWELS, RODS AND LAG SCREWS.—Holes for round drift-bolts and dowels shall be bored with a bit one sixteenth inch less in diameter than the bolt or dowel to be used. The diameter of holes for square drift-bolts or dowels shall be equal to the least dimension of the bolt or dowel.

Holes for machine bolts shall be bored with a bit the same diameter as the bolt.

Holes for rods shall be bored with a bit one sixteenth inch greater in diameter than the rod.

Holes for lag screws shall be bored with a bit not larger than the body of the screw at the base of the thread.

BOLTS AND WASHERS.—A washer, of the size and type specified, shall be used under all bolt heads and nuts which would otherwise come in contact with wood.

The nuts of all bolts shall be effectually locked after they have been finally tightened.

COUNTERSINKING.—Countersinking shall be done wherever smooth faces are required. Horizontal recesses formed for countersinking shall be painted with hot creosote oil, and, after the bolt or screw is in place, shall be filled with hot pitch.

FRAMING.—All lumber and timber shall be accurately cut and framed to a close fit in such manner that the joints will have even bearing over the entire contact surfaces. Mortises shall be true to size for their full depth and tenons shall fit snugly. No shimming will be permitted in making joints, nor will open joints be accepted.

CAPS.—Timber caps shall be placed, with ends aligned, in a manner to secure an even and uniform bearing over the tops of the supporting posts or piles. All caps shall be secured by drift-bolts of not less than $\frac{3}{4}$ -inch diameter, extending at least nine inches into the posts or piles. The drift-bolts shall be approximately in the center of the post or pile.

BRACING.—The ends of bracing shall be bolted through the pile, post or cap with a bolt of not less than five eighths inch diameter. Intermediate intersections shall be bolted, or spiked with wire or boat spikes, as indicated on the plans.

STRINGERS.—Stringers shall be sized at bearings and shall be placed in position so that knots near edges will be in the top portions of the stringers.

Outside stringers may have butt joints with the ends cut on a taper, but interior stringers shall be lapped to take bearing over the full width of the floor beam or cap at each end. The lapped ends of untreated stringers shall be separated at least $\frac{1}{2}$ inch for the circulation of air and shall be securely fastened by drift-bolting where specified. When stringers are two panels in length the joints shall be staggered.

Cross-bridging shall be neatly and accurately framed and securely toe-nailed with at least two nails in each end. All cross-bridging members shall have full bearing at each end against the sides of stringers. Unless otherwise specified in the Special Provisions, cross-bridging shall be placed at the center of each span.

ROADWAY UNDERPLANK.—All underplank shall be tongued and grooved, unless otherwise specified, planed on the sap side to an even thickness and laid sap side up with close joints. Plank shall have a minimum length as specified in the Special Provisions and fastened with spikes of sufficient length to permit penetration of at least one half the length of the spike into the member to which the plank is fastened, two at each end and one at each intermediate bearing. In each plank, intermediate spikes shall be staggered as directed, with the spikes driven alternately in opposing directions. All spikes shall be set $\frac{1}{4}$ inch after driving.

Ends and contact surfaces shall receive two (2) heavy brush coats of wood preservative, and when underplank is to receive a wearing surface of asphalt plank or bituminous concrete, the Contractor shall exercise extreme caution to prevent any wood preservative from coming in contact with the top surface of the roadway underplank and side surfaces of roadway curbs, which surfaces must be kept entirely free from wood preservative or other agents which may injure the bond of asphalt or bituminous materials.

SIDEWALK PLANK.—Sidewalk plank shall be of sizes and type of lumber specified in the Special Provisions and/or on the plans, and shall be laid in single lengths. All pieces shall be planed on the sap side to an even thickness, laid sap side up with $\frac{1}{4}$ -inch joints, and fastened with 40d cement-coated nails, two at each bearing. Nail heads shall be properly countersunk not less than $\frac{1}{8}$ inch and not more than $\frac{1}{4}$ inch below the wearing surface.

WHEEL GUARDS AND RAILINGS.—Wheel guards and railing shall be accurately framed in accordance with the plans and erected true to line and grade.

Unless otherwise specified, wheel guards shall be surfaced one side and one edge (S1S1E) and rails and rail posts shall be surfaced on four sides (S4S).

Wheel guards shall be laid in sections not less than 12 feet long.

WOOD PRESERVATIVE.—Manufacture, treatment and handling shall be done in accordance with the applicable requirements of the manual of the American Wood Preservers' Association, current edition, supplemented by the additional requirements herein noted.

Lumber shall be air seasoned, before treatment, until the moisture remaining in the wood will not prevent the injection and proper distribution of the specified amount of preservation. Steam seasoning for pine and boiling for Douglas Fir may be substituted for air seasoning if permitted by the Commissioner.

In structures of untreated timber the following surfaces shall be thoroughly coated with two (2) coats of hot creosote oil, or such other satisfactory wood preservative as may be approved by the Commissioner, before assembling; ends, tops, and all contact surfaces of sills, caps, floor beams, and stringers; and all ends, joints, and contact surfaces of bracing and truss members. The back faces of bulkheads and all other timber which is to be in contact with earth, metal, or other timber shall be similarly treated.

All treatment shall be done by companies which, in the opinion of the Commissioner, have established reputations for this kind of work. The sources of supply of the materials shall be approved by the Commissioner before delivery is started.

For creosoting to a retention of 12 pounds, the full cell process or the empty cell process may be used. For retention greater than 12 pounds, only the full cell process shall be used. The retention shall be 12 pounds if no other retention is specified.

When salt treatment is specified the lumber shall be treated to a retention of 0.35 of a pound for Wolman salts, 0.75 of a pound for chromated zinc chloride, one pound for zinc chloride, or 0.35 of a pound for zinc meta-arsenite. In each case the retention is in pounds of dry salt per cubic foot of wood. Only one type of salt shall be used throughout for any structure.

All lumber shall be fabricated to the required dimensions in so far as possible before treatment. The Contractor shall keep available at the site the preservatives and equipment for treating all lumber that has been bored for fastenings or otherwise cut after treatment. Bolt holes shall be treated by means of an approved pressure bolt hole treater. Holes that are to remain unfilled shall be treated, then plugged. Cuts in creosoted lumber shall be treated with two applications of a mixture of 60 per cent creosote oil and 40 per cent pitch. Cuts in salt treated lumber shall be brush coated with two applications of the salt solution.

Stringers and other members supporting planking shall be capped with tar paper.

STORAGE OF MATERIAL. — Lumber and timber on the site of the work shall be stored in piles.

Untreated material shall be open-stacked at least 12 inches above the ground surface and piled to shed water and prevent warping. When required by the Commissioner, it shall be protected from the weather by suitable covering.

Creosoted timber and piling shall be close-stacked and piled to prevent warping.

The ground underneath and in the vicinity of all material piles shall be cleared of weeds and rubbish.

WORKMANSHIP. — Workmanship shall be first class throughout. None but competent dock carpenters shall be employed and all framing shall be true and exact. Deep hammer marks in wood surfaces shall be considered evidence of poor workmanship and sufficient cause for removal of the workman causing them. The workmanship on all metal parts shall conform to the requirements specified for Structural Steel.

Treated timber shall be carefully handled without sudden dropping, breaking of outer fibers, bruising or penetrating the surface with tools. It shall be handled with rope slings. Cant hooks, peaveys, pikes or hooks shall not be used.

INSPECTION. — All material will be inspected either at the place of manufacture or upon arrival at the site where it is to be used. Material not conforming in every detail with the requirements of these specifications will be rejected and must be removed from the work by the Contractor.

MEASUREMENT AND PAYMENT

Payment for Timber Structures and Lumber Work shall include the furnishing of materials, preservative treatment, equipment, tools and labor (including all fitting and fastening) necessary for the erection and repair of the work in a satisfactory manner.

Lumber and timber, unless otherwise specified, will be paid for at the contract unit prices per 1,000 feet board measure, under the individual Items covering each size, species and usage, for material remaining in the finished structure. Computation of the amount of lumber and timber in the structure shall be based on nominal sizes. No allowance will be made for waste or cut-off.

Hardware will be paid for at the contract unit price per pound based on tables of weights contained in the latest revision of the Manual of the American Institute of Steel Construction, or such other method of measurement satisfactory to the Commissioner, except where specifically noted in an Item to be included and paid for thereunder.

Old piles, spurs and stubs pulled and disposed of away from the site will be paid for at the contract unit price each, which price shall include full compensation for removal of hardware and any required underwater work.

Redriving old piles pulled, for use as spurs, will be paid for at the contract unit price each, which price shall include full compensation for cut-off, fitting, fastening and blocking. All required hardware for work under this Item will be measured and paid for at the contract unit price per pound, as hereinbefore specified.

Old spur piles cut, refitted and refastened in place will be paid for at the contract unit price per spur pile which price shall include full compensation for all required labor and materials except that hardware will be paid for as hereinbefore specified.

Old lumber removed will be measured and paid for at the contract unit price per thousand feet board measure completely removed and satisfactorily disposed of, which price shall include all labor, tools, equipment and incidental work.

Wood preservative satisfactorily furnished and applied will be measured and paid for at the contract unit price per gallon actually used in the work.

New timber piles furnished and driven will be measured and paid for at the respective contract unit price per lineal foot, as set forth under Section F-3.

MEASUREMENT AND PAYMENT

F10-1 — Lumber	M.F.B.M.
F10-2 — Hardware	Pound
F10-3 — Piles Pulled	Each
F10-4 — Redriving Old Piles Pulled	Each
F10-5 — Old Spur Piles Cut, Refitted and Refastened	Each
F10-6 — Old Lumber Removed	M.F.B.M.
F10-7 — Wood Preservative	Gallon

SECTION F-11

ASPHALT PLANK

GENERAL

The work to be done shall consist of furnishing and placing, where and as directed, a preformed asphalt plank wearing surface composed of asphalt, mineral filler and organic filler, but not wood fiber, brand and quality to be satisfactory to the Commissioner.

MATERIALS

MINERAL-SURFACED ASPHALT PLANK. — Asphalt plank shall be mineral surfaced and shall conform to all the requirements of Designation D-517 of the A.S.T.M. All plank shall have straight edges, square corners and shall be uniform in dimension and weight within the following limits: thickness, plus or minus $\frac{1}{16}$ inch; width, plus or minus $\frac{1}{8}$ inch; length, plus or minus $\frac{1}{4}$ inch; weight, approximately 100 pounds per cubic foot, and all units not conforming to the requirements of these specifications must be removed and replaced with satisfactory plank at the expense of the Contractor.

CEMENT. — Asphalt cement for laying asphalt plank shall be comprised of constituent material, quality and proportioning that meet with the approval of the Commissioner. The selection of any particular brand of asphalt *plank* will in no sense obviate the possible selection of an asphalt *cement* manufactured by others.

CONSTRUCTION METHODS

ASPHALT PLANKING.— Asphalt plank shall be laid in cement, in regular straight courses, breaking all joints, on clean, dry, close-fitting wood underplanking planed to an even thickness and all irregular joints corrected before application of cement. Whole planks shall be used except as required to make closures and to trim around openings and obstructions. Closing and trimming pieces shall be carefully cut to size. Before laying, all surplus talc or other powder shall be removed from the surfaces of the planks with a stiff brush or broom. Each piece of planking shall be laid in a mopping of hot asphalt in a quantity not less than one-half gallon per square yard and the edges and ends of pieces in place and all vertical surfaces which will come in contact with the plank shall be coated with hot asphalt before the next piece is placed. Each individual piece shall be laid tightly against the adjacent pieces and uniformly pressed, wedged, or jacked in place so that the asphalt will completely fill the joints and be squeezed out at the top, and the completed work shall have a uniform smooth surface without open cracks or spaces. All planks shall be pressed, rolled or weighted to secure solid bearing in the cement coating. Plank shall be laid not less than 15 minutes nor more than two hours after the application of the cement.

Unless otherwise specified, six 30d nails shall be driven in each plank as follows: one (1) nail shall be placed at each corner of the plank spaced not less than one and one-half inches and not more than two inches from the corner edges of the plank; and one (1) nail at the mid-point of each long side, not less than one and one-half inches and not more than two inches from the edges. Nail heads shall be countersunk not less than $\frac{1}{8}$ inch and not more than $\frac{1}{4}$ inch below the wearing surface.

Asphalt plank shall not be laid during cold or inclement weather, nor when the under-deck is wet or damp. In general, the Contractor shall not proceed with laying the plank until the Commissioner is fully satisfied that all conditions affecting this work are satisfactory.

Since creosote and certain other wood preservatives are very active solvents of asphalt, the Contractor shall exercise extreme caution to prevent any such preservative, or other agents which may injure the bond of the cement, from coming in contact with any abutting surfaces.

MEASUREMENT AND PAYMENT

Asphalt plank will be measured and paid for at the contract unit price per square foot of Asphalt Plank, complete in place, which price shall include full compensation for all materials, labor, equipment and tools used to do the work as specified.

PAYMENT ITEM

F11-1 — Asphalt Plank.....	Square Foot
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SECTION F-12

CLEANING AND PAINTING EXISTING STRUCTURES

GENERAL

This Item shall consist of cleaning and painting all steel and other metal work including fences and handrails as specified on the plans or in the Special Provisions.

The work shall commence immediately after the execution of the contract, weather permitting, and shall continue without cessation until completed.

The Contractor shall so conduct his work that there will be no interference with navigation, automobile or pedestrian traffic. He shall have no claim for delay or for additional work due to the opening of a drawbridge.

No work shall be done under the contract on Saturdays, Sundays, or legal holidays without the prior approval of the Commissioner.

MATERIALS

All paint for work to be done under this Item, and materials, equipment and methods incidental thereto shall conform to the relative requirements contained in these Standard Specifications, under Section F-7.

CLEANING AND PAINTING METHODS

The Contractor shall thoroughly and completely remove all dust, dirt, debris, scale, rust or other foreign matter from all surfaces to be painted by the use of metal scrapers, pneumatic scalers, wire brushes and hammers as directed. Oil and grease shall be removed by the use of approved solvents. Sound paint adhering to uncorroded metal need not be removed, but the paint must be thoroughly cleaned. Paint which can be removed by a reasonable use of a putty knife will not be considered to be sound paint.

Metal surfaces laid bare shall not be painted until such surfaces have been examined by the Commissioner's inspector and found to be satisfactory structurally, and properly prepared for painting.

Metallic surfaces shall not be laid bare in damp or freezing weather or when, in the opinion of the Commissioner, the weather is otherwise unsuitable.

Cleaning of steelwork by the sand blast method will not be permitted unless specified in the Special Provisions or unless written permission is granted by the Commissioner. When sand blasting is so permitted, the Contractor shall provide ample and suitable protection for the operating machinery, traffic and pedestrians, and shall exercise extreme caution to avoid damage or injury thereto and shall protect the City from all claims for damages or injury arising from his work.

The Contractor shall perform such other cleaning as may be required or directed in connection with the work under the contract (and which is not specifically covered by other Items in the Proposal) such as cleaning off the tops of masonry piers to permit inspection, repair and replacing of masonry plates, bearing plates and expansion plates, and removing dirt, debris and foreign matter from around column bases as required to expose all steelwork and connections.

Three (3) heavy coats of asphalt base paint shall be applied to designated sections such as locations more or less inaccessible for routine maintenance and inspection, contact surfaces between wood and steel, exposed metal work below the bridge floor line, and wherever water or condensation may accumulate. This paint shall specifically qualify as a durable, waterproof, protective coating capable of resisting corrosion, electrolysis and chemical action.

As soon as a metallic surface has been laid bare, satisfactorily cleaned, inspected and repaired if required, it shall be given a patch coat of Structural Red Lead Paint.

After all patch painting is completed, has thoroughly dried, and all members are covered with sound clean paint, the structure shall receive one (1) complete coat of Structural Intermediate (Maroon) Paint and one (1) complete coat of Structural Blue Lead Gray Paint applied as specified in Section F-7.

The final coat of paint shall be sufficiently tinted to permit visible detection of incomplete application.

In addition to the foregoing, the Contractor shall prosecute the work in accordance with all the applicable requirements of Section F-7.

PAYMENT

Cleaning and Painting will be paid for at the contract lump sum price, which price shall include full compensation for all material, labor, tools, equipment (including staging and floating equipment) and other incidental work and the satisfactory disposal of all dirt and debris.

The work under this Item will not be considered completed until the entire work and any adjacent premises, streets or sidewalks occupied by the Contractor are thoroughly cleaned and left in a neat and presentable condition satisfactory to the Commissioner.

PAYMENT ITEM

F12-1 — Cleaning and Painting Lump Sum

PART VI

STANDARD SPECIFICATIONS OF SEWER DIVISION

GENERAL PROVISIONS FOR SEWER DIVISION

Including the General Provisions set forth hereinbefore under the Standard Specifications of the Highway and Bridge Divisions, and without limiting the generality thereof, the following General Provisions are added at this Part VI of the Standard Specifications of the Public Works Department as being conditions more specifically pertinent to Sewerage Works.

The Contractor shall thoroughly examine the site of the work, consult plans on file in Room 706, City Hall Annex, and familiarize himself with all the sewers, surface drains, underdrains, tide gates, overflows, brooks, culverts, etc., which may directly or indirectly affect the progress of the work, and shall perform all work in accordance with the following:

(a.) Construct the sewerage works and appurtenances set forth in the contract and, unless otherwise clearly provided for in these specifications, furnish and do to the satisfaction of the Commissioner everything required for the above, and of the best, and so that there will be no defect in the work or in the operations thereon, due to inferior materials or workmanship or the unworkmanlike placing of any part or parts; the Commissioner to be in charge of the work, acting either directly or through his properly authorized agents, within the scope of the particular duties intrusted to them.

(b.) The City will furnish, at the City Sewer Yard, any materials as may be noted in the Special Provisions of the contract and the Contractor only after obtaining a written order from the inspector and it has been determined that the materials are ready for delivery, shall haul from the aforementioned Sewer Yard to the work, at his own expense, iron manhole frames, covers and steps, lamphole frames and covers, combination manhole castings, cast-iron plugs, cast-iron and steel pipes, catch-basin and drop-inlet frames, covers, grates and traps, iron gratings and cut stone for catch basins and drop inlets, and if required, shall haul the iron pipe from any yard of the Water Service to the work at his own expense. All materials so hauled by the Contractor and not used in the work shall be returned to the yard at his expense. If hauled back by the City, the cost of hauling shall be deducted from the Contractor's estimate. These are to be built in the masonry or laid in place as shown on the plans or as directed by the Commissioner; and the Contractor shall give sufficient notice to the Commissioner of the different kinds of materials required from time to time. The Contractor shall provide for the safe keeping and proper protection of all materials so furnished to him.

(c.) All other materials are to be furnished by the Contractor on the line of the work, and there, under the inspection of an assistant of the Commissioner, the Contractor is to cull all old materials and all new materials, whether furnished by him or others, and use only such thereof as shall be approved by the Commissioner; all materials not so approved are immediately after inspection to be removed from the place and its vicinity as directed by the Commissioner.

(d.) Any old materials found in the excavations may be kept by the City, if so directed by the Commissioner, and such materials shall be conveniently placed by the Contractor for removal by the City.

(e.) The work is to be water-tight, and if, within one year after its completion, leaks are discovered the openings are to be calked or otherwise stopped, at the expense of the Contractor, to the satisfaction of the Commissioner.

(f.) Subject to the provisions contained hereinafter under "Refilling," any settlement or other defect that shall, within one year after the work is completed, appear on or adjacent to the work is to be repaired by the Contractor *within forty-eight hours of notice thereof from the Commissioner, provided, however,* that whenever the Contractor fails to so repair, or whenever, in the opinion of the Commissioner, emergency demands that repairs be made forthwith, the City shall make the necessary repairs, and the expense thereof shall be paid by the Contractor or deducted from his final estimate.

SECTION G-1

UNIFORM SPECIAL PROVISIONS

FOR

SEWER DIVISION CONTRACT ITEMS

1. EXCAVATIONS.—(a.) Subject to the provisions contained in the paragraphs under the following titles, “Obstructions” and “Rock Excavation,” under these Uniform Special Provisions, the prices named under all Items for or requiring excavation are to include the excavation of all materials including existing street pavement with its concrete base or base of other material, including grouted block, sidewalks, driveways, edgestones, crosswalks, etc., the excavation for pipe underdrains (including furnishing and laying of underdrains), manholes, all extra excavation required on account of the use of steam hammer or other equipment used for pile driving, and other structures appertaining to the work, and disposal of material by refilling and by removal of surplus material. They are likewise to include the furnishing, placing and removal of all sheeting and shoring not left in place; the cutting off, at the proper grade, of such existing piles as the Commissioner may direct to be utilized in the work; all bridging and fencing and removal of same, unless otherwise required by the Commissioner; all pumping, bailing or otherwise disposing of water; the proper handling of all sewage, storm water or flow in existing adjacent sewers, surface drains, overflows, underdrains, or other conduits or upon the surface of streets or lands; the removal of all sheeting and shoring of existing structures; the building and removal of all temporary bulkheads; the removal and replacing of such portions of existing structures as may be necessary to make proper connections with new work; the removal or bulkheading where necessary of pipes, conduits, sewers, overflows, underdrains, drains, manholes, catch basins and similar existing structures, together with their contents, and including stonework, woodwork, ironwork, reinforced concrete, plain concrete, cemented stone, brick masonry, interior bracing, foundations, platforms and other foundation lumber and piling; all protection, supporting and restoration of all buildings, walls, fences, trees, water pipes, conduits, appurtenances, and other existing structures; all resurfacing of streets, and private land, accommodation and protection of travel, and all other incidental work. All water pipes adjacent to excavations or encountered therein shall be supported and maintained in a manner satisfactory to the Water Service.

(b.) The excavations are to be made to the lines and grades shown on the plans and to such further depths and widths and in such manner as will give ample room for removing old structures, building the structures to be placed therein, and for bracing, supporting, pumping and draining and for removing any materials which the Commissioner may not deem proper for a foundation. Where sheeting is used, the excavation shall be made sufficiently wide at the surface to admit of packing being placed and maintained behind the sheeting, so as to prevent gravel or other loose material from following the sheeting as driven. Where excavation is by machine, the trench, from a point level with the top of the pipe to the grade line, must be excavated by hand labor and the width of trench at this point shall be limited to two (2) feet greater than the outside diameter of the bell of the pipe.

(c.) Where, in the opinion of the Commissioner, it is necessary to increase the normal excavation width, the Contractor shall be paid for the additional excavation and refill required, under the Item for “Cubic yards of earth excavation above grade, in outside trench for all purposes and not shown on plans”, of the proposal.

(d.) Where an excavation item includes sewer and surface drain in a single trench the price bid is to include, in addition to the work set forth in paragraph (a), the laying of all pipes and underdrains called for in the item.

(e.) The excavations are to be opened in as many places and in such lengths of sections as the Commissioner shall direct, and the work carried on in each place by a separate gang, consisting of as many men as he shall require.

(f.) Due care shall be taken to remove and preserve in good condition, as the property of the City, as much as is possible of old water pipe and sewer pipe met with in the excavations. Water pipes are to be carefully separated at the joints, in lengths not exceeding twelve (12) feet, and conveniently placed for removal by the City.

(g.) Subject to the provisions contained in these Uniform Special Provisions under the heading of "Refilling," and unless otherwise provided in the Special Provisions, all surfacing material removed, including paving blocks, crushed stone, gutter and crosswalk stones, paving gravel sidewalk bricks, edgestones, etc., are to be kept separate and stored by the Contractor, to be again used in replacing the roadbeds, sidewalks, edgestones, etc. All surface loam is to be saved and replaced in its original position. All stone bounds are to be preserved and reset as required.

(h.) The grade line is the line to which the excavations are to be made, and is as follows: Where a concrete foundation is used it is the underside of the concrete; where a timber foundation is used it is the underside of the platform or ribs; where piles are used it is the underside of the pile caps, except that where no caps are used it is the underside of the concrete; where suitable refill or gravel is used as a foundation in pipe trenches, it is eight inches below the invert; where no foundation is used it is the underside of the lowest part of the structure to be placed therein.

(i.) All excavations are to be maintained in good order at all times so as not to hinder or injure the masonry or other work; pumps are to be used to keep them free from water, and are to be shifted frequently to avoid drainage from too long a distance. Where deemed necessary by the Commissioner, they shall be operated continuously, day and night, to avoid injury to newly laid masonry, pipes, etc.

(j.) All pump wells shall be located outside the trench lines at such intervals as may be determined by the Commissioner and shall be excavated to and maintained at a depth of not less than four (4) feet below the invert of any underdrain emptying into such pump wells.

(k.) No earth excavation is to be paid for in trench for underdrain or pump wells, or for pipe and fittings used for underdrain.

(l.) All sheeting, planking, timbering, bracing and bridging is to be under the control and direction of the Contractor, and he shall be responsible for renewing it and keeping it in repair as long as is necessary and shall be liable for any accident which may occur in consequence of any defect therein. Its character and condition shall be satisfactory to the Commissioner, whose representations in regard thereto shall be observed by the Contractor. As fast as any timbering, planking, bracing, sheeting, etc., becomes unnecessary, the Contractor shall take it up and, in the case of street or sidewalk, put the surface in proper condition for traffic. In case it becomes necessary to remove or change planking, timbering, etc., in order to relocate pipes or conduits as ordered by the Commissioner, the Contractor shall make such change upon the written order of the Commissioner and shall be paid for the same as extra work, according to Articles 2 and 3 of the contract. This shall not be construed, however, as relieving the Contractor from any responsibility as to the timbering or structures, and he is not to prevent the companies owning structures in the street from inspecting or doing work on said structures not ordered by the Commissioner, but may make for these companies in such cases reasonable regulations, subject to the approval of the Commissioner, in regard to the handling of the bridging and bracing for which the Contractor is responsible.

(m.) The Contractor shall assume all liability for floods or damages caused by his construction in connection with the contract.

(n.) The Contractor shall have no claim for damages or for extra work from flooding by storm water, or from intercepting sewers or common sewers, overflows, or underdrains, leaking or backing up, or from removal or placing of dams or obstructions on any part of the work, whether or not by orders of the Commissioner, or from accident on any other part of the work or from flooding by water backing up on account of any failure of tide gates to work properly, or from blocking up of existing screens or conduits, culverts or other structures.

EXCAVATION AND FOUNDATION WORK *OTHER* THAN SUCH WORK SPECIFICALLY NOTED AS BEING INCLUDED AND INCIDENTAL UNDER PARTICULAR PROPOSAL ITEMS.

(a.) If, in the opinion of the Commissioner, it is necessary to lower the grade line, for any purpose, or to excavate below the grade line shown on the plans, or in "outside trench," for any purpose, it is to be removed to such depths and widths and in such manner as he may direct.

(b.) All excavations below the grade line are to be refilled to grade line with such material and in such manner as the Commissioner shall direct and such filling is to be confined in place by poling boards or sheeting, placed vertically, in a manner satisfactory to the Commissioner.

(c.) When, in the opinion of the Commissioner, the sheeting or shoring cannot be removed it shall be left in place. The Contractor shall be paid for the lumber so left in place at the rate provided in the Item for "two or three-inch lumber furnished and used for sheeting, or other purposes, and left in place" of the proposal. No payment shall be made for sheeting which extends more than two (2) feet above the ground surface. Timber left in place shall be cut off at least two (2) feet below the surface.

(d.) Payment for "planed and matched" sheeting will be made in each case, with no allowance for wastage due to tongues and splines respectively.

(e.) In the case of timber, other than "planed and matched" sheeting, being left in the trenches, no thickness of sheeting over two (2) inches and no other lumber exceeding in size that customarily used shall be paid for unless the use of such larger sizes shall have been ordered in writing by the Commissioner.

(f.) Piles, when listed in the Proposal as a contract Item, shall be furnished, driven and paid for in accordance with all the applicable provisions and requirements of Section F-3, the Special Provisions, any plans included therewith and the following:

Piles are to be furnished by the Contractor and driven to support foundations; they are to be driven in bents or otherwise, as shown on the plans or as directed. They are to be replaced by the Contractor at his expense where broken in driving or where driven off line; they are to be—straight, sound spruce or fir sticks, free from defects—at least ten (10) inches in diameter except as otherwise ordered by the Commissioner at the point where they are to be cut off—not less than six (6) inches in diameter at their lower ends—and of sufficient length to drive well into the hard bottom, to the satisfaction of the Commissioner.

Each pile, whether newly driven or an existing pile, to be utilized in the work is to be cut off by the Contractor at the grade given by the Commissioner, exactly level, so that the cap or concrete which rests on it will have a firm and even bearing. In determining the length of new pile to be paid for, the part sawed off is not to be deducted unless it exceeds two (2) feet in length, in which case all but two (2) feet of the length sawed off is to be deducted.

Pile-caps, if used, are to be of the dimensions shown on the plans or as directed by the Commissioner, and are to be securely fastened to the piles by oak tree-nails sixteen (16) inches long and one and one quarter ($1\frac{1}{4}$) inches in diameter or by 1-inch bolts and washers.

The spaces between the piles and the pile-caps are to be refilled by the Contractor with suitable material, compacted to a level with the tops of the caps.

Tests to establish the penetration of the piles will be made from time to time and the Contractor shall furnish all reasonable facilities for this work. Each pile shall be capable of supporting a load of twelve (12) tons, based on the results of the penetration measurements applied to the Engineering News formulas for calculating the safe bearing power of piles.

The piles are not to be driven until the trench has been excavated to the grade line.

Guide piles and waling pieces left in place will be paid for upon written approval and order of the Commissioner, and at the price bid per linear foot in place under the item for "Spruce or fir piles, for any and all lengths, furnished, driven and sawed off", in the proposal, which price shall include full compensation for waling pieces and all other lumber incidental to the piling system.

PAYMENT ITEMS

G1-1 — Excavation Below Grade.....	Cubic Yards
G1-2 — Excavation In "Outside Trench".....	Cubic Yards
G1-3 — Old Lumber Removed.....	M. F. B. M.
G1-4 — Lumber Sheeting Left in Place.....	M. F. B. M.
G1-5 — Other Lumber Left in Place.....	M. F. B. M.
G1-6 — Timber Piles.....	Linear Feet

2. ROCK EXCAVATION.— (a.) No soft, loose or broken rock, impacted boulders, or hardpan, but only such solid rock, as may be approved by the Commissioner in advance as requiring blasting for its removal, and boulders of one and one-half ($1\frac{1}{2}$) cubic yards or more found in and removed from the excavation, are to be considered as rock excavation to be paid for at the price named under the item of the proposal marked "Rock Excavation," said price being understood as covering the extra cost of rock excavation over the prices named for earth excavation and refill; *nevertheless*, the Commissioner may pay to the Contractor such portion of said price as he may deem equitable for soft, loose or broken rock, or impacted boulders. All rock, other than for underdrain excavation, will be measured from its surface as it was before removal to a depth of six (6) inches below the grade line, and to a width — not being less than three (3) feet where the full width of trench is solid rock — of six (6) inches beyond the outside lines of the structure, as shown on the plans or as indicated by the Commissioner, except, however, that this provision shall not apply to concrete placed for protection and refilling around pipe structures. Where old trenches are encountered, only the undisturbed solid rock found within the foregoing limits and solid pieces of rock one and one-half ($1\frac{1}{2}$) cubic yards and over are to be allowed and paid for as rock excavation. For boulders the actual dimensions will be allowed in case the volume exceeds one and one-half ($1\frac{1}{2}$) cubic yards.

(b.) Blasts in the excavation are to be covered with heavy timbers, chained together and covered with canvas, or covered by a blasting mat, or otherwise covered to the satisfaction of the Commissioner. Prior to blasting, a wooden stopper shall be inserted in the bell of the last pipe laid, and no pipe shall be laid in place within thirty (30) feet of the face of the excavation when blasting.

(c.) The Contractor, in addition to observing all City ordinances, State Laws, and the Rules and Regulations of the Board of Fire Prevention, State Department of Public Safety, Form FPR-12, March 7, 1958 relating to the storage and handling of explosives, shall also conform to any further regulations which the Commissioner may deem necessary in this respect. Caps or other exploders are in no case to be kept in the same place in which dynamite or other explosives are stored, and all precautions against accident from blasting or the use of explosives are to be taken, and the Contractor is to be liable for all damage to persons or property caused by storage and handling of explosives, blasts or explosions.

(d.) Rock excavation in trench for underdrain is to be paid for to a width of two (2) feet, and to a depth of six (6) inches below the outside of the bottom of the pipe and is to be excavated to such depth.

(e.) The decision of the Commissioner in regard to classification and payment is to be final and binding upon all parties, and it is to be distinctly understood that, except as decided by him in virtue of the provisions of this section and of those relating to "Obstructions," no payment will be made for excavation and refill other than the inclusive prices named in the proposal for earth excavation and refill per linear foot of trench. The intended effect of this stipulation is that, except as contemplated in these provisions, the Contractor shall bear all costs and take all risks, of whatever description, arising in the work of excavation, backfilling and the restoration of all surfaces interfered with, even though such costs and risks shall arise from hardpan, quicksands, silt or other difficulties not specifically within the scope of said provisions.

PAYMENT ITEM

G1-7 — Rock Excavation.....	Cubic Yards
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3. OBSTRUCTIONS.—(a.) Payment will not be made for the removal of natural obstructions, such as trees, shrubbery, plants, stumps, roots, etc., visible in whole or in part before beginning the work. Where this condition does not apply payment will be made under the Item of the proposal marked "Old lumber removed."

(b.) Payment will not be made for additional work caused by artificial obstructions encountered in the excavations, if

(1) Visible in whole or in part before beginning the work, or (2) shown on plans, or (3) items to be removed under the provisions as hereinbefore set forth under "1. Excavations," or (4) removal of old wooden railway ties where tracks are shown on plans.

(c.) For other additional work caused by artificial obstructions encountered in the excavations, payment will be made as follows:

Old stone walls, stone foundations, concrete walls, etc., laid in mortar, will be paid for as rock excavation. For piles, caps, platforms, cribwork, bulkheads and other timber requiring removal and not shown on plans payment will be made under the Item of the proposal marked "Old Lumber Removed." Other unforeseen artificial obstructions not specifically excluded in the next following sentence will be paid for as Extra Work (Articles 2 and 3). Payment will not be made for brick masonry in old building foundations, catch basins, drop-inlets and manholes, or for dry stone walls (including those having jointed faces), except as regards stones of one and one half ($1\frac{1}{2}$) cubic yards or more, which will be paid for as boulders under the provisions of "2. Rock Excavation."

4. FOUNDATIONS.—(a.) The precise character of the foundation at any given point cannot be determined in advance, but is to be decided upon and may be changed by the Commissioner as occasion demands, and generally is to be of such form, dimensions and materials as the Commissioner shall direct.

(b.) If the bottom of an excavation is of gravel or rock, as aforesaid, as is suitable, it is to be the foundation.

(c.) If the bottom of an excavation is excavated and refilled with gravel for a foundation, the sides of the deepened excavation shall be supported by poling boards and temporary braces.

(d.) If the bottom of an excavation is excavated and refilled with concrete for a foundation, the concrete is to be as hereinafter described.

(e.) If a timber foundation is used it is to consist of sills, laid as directed, and a platform or flooring of plank or boards, spiked to each sill with suitable cut spikes; great care is to be taken to prevent any washing away of the materials under the timber.

(f.) The Contractor may, with the approval of the Commissioner, use such old lumber found in the trench as is suitable for platforms. If such lumber is used, no thickness greater than that shown on the plans will be paid for, and no payment will be made for excavation below grade caused by such additional thickness.

5. REFILLING.—(a.) The greatest care is to be taken in refilling; the best materials taken from the excavations, in the condition in which they are found, are to be used, unless ordered by the Commissioner to refill with bank gravel under the Item in the Proposal for, "Clean bank gravel furnished and placed."

(b.) No payment will be made to the Contractor for refilling with excavated material found within four hundred (400) feet of the place where it is to be deposited.

(c.) Refilling of trenches shall be performed by hand labor where directed. Filling material shall be free from large stones and shall be carefully tamped beneath and around the pipes and other structures, special care being taken not to injure their alignment. The remainder of the filling shall be spread in thin layers, well watered and thoroughly rammed. Where permitted by the Commissioner, backfill may be consolidated by puddling with a sufficient quantity of water.

All backfill and contiguous surfaces, as well as all excavated material, shall immediately, where backfilled, be sprinkled with road oil and as often as may be required to lay the dust, until such time as the street or surfaces have been put in normal condition and the dust nuisance shall have disappeared.

(d.) Special care shall be used in consolidating the filling between sewers and surface drains laid in the same trench.

(e.) Subject to the provisions of "Temporary and Permanent Paving for Trenches," all surfacing material found in the excavation is to be carefully kept apart from all other excavated material, and replaced upon the top after the excavation is refilled, and the street is to be repaved or surfaced in as good a condition as it was before the work was commenced therein.

(f.) Granite paving, edgestone, flagging and brick sidewalks removed shall be relaid and maintained in a satisfactory condition, payment therefor to be included under Items of the proposal requiring excavations. Granolithic sidewalks in public ways shall be replaced by the Contractor where directed in accordance with the requirements of Section G-4.

PAYMENT ITEMS

(Applies only where such work is specifically excluded as incidental to a particular Item in the Proposal.)

G1-8 — Clean Bank Gravel.	Cubic Yards
G1-9 — Clean Screened Gravel or Broken Stone.	Tons

SECTION G-2

G2-1 to 9 etc. SEWERS AND DRAINS

GENERAL

Pipe sewers and drains shall consist of sections of pipe of the kinds and sizes shown on the plans, as specified in the Special Provisions, and as directed, laid on a firm foundation in a trench in accordance with these specifications and as directed.

MATERIALS

Pipe.—All clay or shale pipes furnished and used shall conform to the American Society for Testing Materials specifications for clay sewer pipe, "Serial Designation C-13," except where extra strength clay pipe is specified it shall conform to the American Society for Testing Materials specifications for extra strength clay pipe, "Serial Designation C-200," of the latest revision. All cement concrete sewer pipe furnished and used shall be bell and spigot type, machine made, and shall conform to the American Society for Testing Materials specifications for cement concrete sewer pipe, "Serial Designation C-14" for nonreinforced concrete sewer pipe, "C-75" for reinforced concrete sewer pipe, and "C-76" for reinforced concrete culvert pipe, respectively, of the latest revision.

Where use of cement concrete sewer pipe is permitted, the same shall be used for structures carrying surface water only.

All pipe used for testing purposes will be paid for by the City, at the cost to the Contractor.

Asphaltic compound shall be of a standard type manufactured for this use (such as G-K, or equal) as determined by the Commissioner.

CONSTRUCTION METHODS

The spigot end shall first be inserted into the bell of the preceding pipe and centered and held in place by calking a ring of dry jute, oakum or hemp about it and against the bottom of the bell, and this ring, in place, must not exceed a depth equal to one fourth the depth of the bell, and then the properly heated compound shall be poured into the annular space by aid of the necessary "snake-runner", (the gate of which shall be slightly off center), clamps, etc. Due care must be taken to see that the annular space be free from all foreign matter before the joint is poured and this pouring must be completed in one operation. The Contractor may connect two, or more, pipes before placing them in the work, provided the same be done in a workmanlike manner with the adjacent pipes carefully aligned. All pipe shall be laid on an upgrade with the socket at the upper end.

Surface drains may be laid with mortar joints, at the discretion of the Commissioner.

Mortar joints shall be made by hand, with a rubber mitt, and are to be filled with mortar after calking jute and made watertight, the lower quarter of the annular space of the bell to be filled with mortar before the spigot end is inserted.

The pipes are to be laid under the personal supervision of the inspector in charge of the work, and are to be evenly bedded so that no uneven strain will come on any pipe, special care being taken to prevent the pipes from bearing on the joints.

Immediately after each two lengths of pipe making a joint are laid, a closely fitting disk is to be drawn through them and all obstructions removed from pipes and joints.

Y's, slants and pipe connections are to be placed in pipes, manholes or other structures and, where not connected, properly plugged by vitrified stoppers sealed watertight with asphaltic compound prepared as for pipe joints, unless otherwise ordered; all masonry work is to be done which is necessary to make up the joint in a good and workmanlike manner.

No line of pipe is to be covered until it has been examined by the inspector and directions given to that effect.

Drain pipes for underdrains are to be laid below the sewers or surface drains where and as directed by the Commissioner; they are to be laid with open joints, the joints wrapped in one thickness of muslin, the pipes bedded in screened gravel or broken stone, the latter to be furnished by the Contractor, and the refilling placed solidly about them. All pipes laid below the structures within the limits of the trench, for trench drainage purposes, are to be included as underdrain. Payment for excavation and furnishing and laying of underdrains shall be included under the items for or requiring excavation. (See Section G-1 — 1. Excavations).

T's for plugging the underdrain are to be turned up in the invert of the manholes at such intervals as may be directed and the underdrain carefully plugged upon the completion of the work.

Pipes for chimneys are to be placed where and as directed by the Commissioner, and are to be incased in Class B concrete, five (5) inches in least thickness around each chimney and shall be held in place by barrels or other suitable forms, which are to be left in place when the trench is backfilled. Concrete eight and one half ($8\frac{1}{2}$) inches in least thickness shall be placed around the main sewer and branch as a foundation for the chimney.

Minor drains shall include house, roof water, catch basin drains and pipe chimneys, but not underdrain.

All pipes, other than for underdrain, are to be watertight, and laid with asphaltic compound joints, and on the foundation prepared as aforesaid therefor.

MEASUREMENT AND PAYMENT

The prices bid under all items involving the use of pipe are to include the furnishing of all straight pipe, bends, branches, slants, stoppers specials, etc., and the jointing material and laying of same as shown on plan or required by the Commissioner. All straight pipe, bends, branches, slants, stoppers, specials, etc., furnished and laid by order of the Commissioner but not shown on the plans or not specified shall be paid for at the cost to the Contractor as shown by Contractor's original invoice for same.

All pipes, other than for underdrain, are to be water-tight, and laid with asphaltic compound joints, and on the foundation prepared as aforesaid therefor.

The length of any sewer or surface drain trench and pipe to be paid for is to be determined as follows:

When the new sewer or surface drain starts from an old manhole, the trench measurement starts at the center of that manhole. When the new sewer or surface drain starts from an old structure otherwise than at an old manhole, the trench measurement is to start at the inside face of the old structure provided the latter is greater than three feet in width, and is to start at the center of said old structure when the latter is three feet in width or less. When the new sewer or surface drain ends at a manhole, either old or new, the trench measurement ends at the center of said manhole, and when the sewer or surface drain ends without a manhole, the trench measurement ends on the line of the completed new structure. When a sewer and surface drain are laid in the same trench, the length to be paid for shall be the length of sewer as determined above.

Concrete for chimney foundations will be paid for under the respective Item for the Class of concrete used.



